THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 79 MAY, 1958 No. 5

PEPTIC ESOPHAGITIS AND PEPTIC ULCERATION OF THE ESOPHAGUS*

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ESOPHAGITIS as a result of chemical agents, for example lye, or caused by physical trauma, for example intubation, or associated with persistent vomiting or occurring as a terminal event are well known types of esophagitis that require little comment. In recent years, however, it has become generally realized that a chronic esophagitis of variable severity is often present as a complication of a direct, concentric type of hiatus hernia.[5] The connecting link between herniation and esophagitis appears to be reflux of acid peptic juice into the esophagus, especially at night.[6] In 1935, Winkelstein[10] described "peptic esophagitis" as a clinical entity associated with duodenal ulcer. The presence of a hiatus hernia as a feature of this syndrome was not emphasized at that time. It is now recognized, however, that the triad of duodenal ulcer, direct hernia and peptic esophagitis is of special clinical significance.[11] In 1943, Allison, Johnstone and Royce[1] described in detail a group of cases with ulceration of the terminal esophagus which showed regularly a hiatus hernia of the direct or short esophagus type. The title of this report was "short esophagus with simple peptic ulceration." In 1946[2] and in 1948[3] Allison indicated that he considered this condition and peptic esophagitis to be stages or variations of the same process. He believed that diffuse inflammatory changes in the distal esophagus (peptic esophagitis) might be followed by or associated with more discrete ulceration of the terminal esophagus (simple peptic ulceration) which might persist or recur and eventually lead to a stricture (peptic stenosis). In these papers, Allison used the title "peptic ulcer of the esophagus" to include all stages of the process.

A fundamental contribution to the subject was made in 1950 by Barrett[7] who pointed out that, in some individuals, a remarkable developmental anomaly of the epithelium lining the distal esophagus exists; namely, a cylindric type of epithelium is present instead of the normal squamous variety. It would appear that this rep-

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Presented at the Fifty-seventh Annual Meeting of the American Roentgen Ray Society, Los Angeles, California, September 25–28, 1956.

resents a persistence of embryonic epithelium which ordinarily is replaced progressively from above downwards by squamous epithelium. If this process is incomplete, a variable portion of the distal esophagus remains lined by this unusual, Barrett type of epithelium. To some degree, this epithelium resembles the epithelium of the cardiac region of the stomach, but the glands are relatively atrophic and do not show parietal cells or secrete pepsin. Esophageal mucous glands are present in the submucosa. This condition of "heterotopic gastric epithelium" in the esophagus[7] or "gastric-lined esophagus"[4] is distinct from the rare instance of a discrete island of gastric mucosa in the distal esophagus, that is "ectopic gastric epithelium." An ectopic island consists of normal gastric epithelium which grossly resembles stomach and microscopically shows the presence of oxyntic cells. In heteropia, the atypical cylindric epithelium exists as a complete sheet, continuous distally with the normal gastric epithelium of the stomach. In ectopia, an island of gastric mucosa is dislocated proximally and is separated from the gastric epithelium of the stomach by the squamous epithelium of the esophagus. Barrett also pointed out that heterotopic epithelium was susceptible to ulceration under the influence of acid gastric juice and that published case reports of "chronic peptic ulcer of the esophagus" showed in addition to the ulceration the presence of heterotopic epithelium. He, therefore, suggested that the term "chronic peptic ulcer of the esophagus" be retained for ulceration in heterotopic epithelium and that a new term, "reflux esophagitis," be applied to inflammation and ulceration of a normally lined esophagus in association with a hiatus hernia.

In 1953[4] Allison and Johnstone accepted the findings and nomenclature of Barrett and reported several instances of gastric-lined esophagus. These authors suggested that alternatively the eponymic term, "Barrett ulcer," be applied to peptic ulceration in heterotopic epithelium, that is to a chronic peptic ulcer of the esophagus as described by Barrett. They also agreed that a Barrett ulcer resembled in its course an ordinary gastric ulcer in that perforation and massive bleeding might occur but that severe stricture formation was unlikely. In contrast, ulceration in normal squamous epithelium remained more superficial, did not perforate or bleed massively, but might be associated with circumferential stenosis due to submucosal fibrosis.

The cases described by Allison and Johnstone[4] illustrate the diagnostic difficulties that may arise in the presence of Barrett type of epithelium. Heterotopia may apparently exist throughout life without causing any clinical symptoms and be unsuspected on roentgen or esophagoscopic examination. If, however, the esophagus is also congenitally short or if, in later life, a direct type of hiatus hernia is acquired, the associated reflux may lead to inflammation and/or ulceration of the gastric-lined segment or of the more proximally located normally lined esophagus or both portions of the esophagus may be involved. If discrete ulceration and/or stenosis can be demonstrated several centimeters proximal to a herniated pouch of the stomach, it is likely that the distal esophagus is lined by the Barrett type of epithelium. Without microscopic study, however, it is still not possible to assert with confidence that the discrete ulceration or stenosis visualized lies entirely within the gastric-lined portion of the esophagus or whether it lies proximal to it, that is, in normally lined esophagus, or at the junction of the two portions. Incidentally, this junction is often poorly demarcated in the sense that long digitations and islands of heterotopic and squamous epithelium may coexist in the same region since the junctional area is actually lined by an admixture of the two varieties of epithelium. It is obvious that additional diagnostic difficulties arise if the gastric-lined segment is short and if ulcerative changes make it impossible to recognize the original status of the epithelium. At the time of a previous report by the

present authors[12] on "short esophagus with esophagogastric or marginal ulceration," these difficulties were not appreciated and the possible significance in several instances of the finding of only gastric epithelium on repeated biopsies was not realized. In this connection, it should be noted that gastric epithelium was also reported in 4 of 8 cases described by Allison, Johnstone and Royce in 1943, in which biopsies showed recognizable epithelium. In the series of cases of regurgitant ulceration at the esophagogastric junction reported by Schmidt,[8] biopsy of the ulcers showed gastric epithelium in 56 cases, esophageal epithelium in 14 cases, both gastric and esophageal epithelium in 3 cases and the type of epithelium was not mentioned in 52 cases. It would appear, therefore, that cases of short esophagus with simple peptic ulceration,[1] of short esophagus with esophagogastric or marginal ulceration[11] and of regurgitant ulceration at the esophagogastric junction[8] may be associated with minimal or a varying degree of heterotopic gastric epithelium which may be impossible to recognize without microscopic study.

The diagnostic difficulties introduced by the possible presence of a gastric-lined segment of esophagus are diagrammatically illustrated in Figure 1 and 2. The exact nature of a peptic ulceration, that is, whether it is a Barrett ulcer, whether it is occurring in normal squamous epithelium and may, therefore, be considered a reflux ulcer, or whether it is a variation of peptic or reflux esophagitis, must often await microscopic examination. It is reasonable to speak of peptic or reflux esophagitis when the esophageal changes are diffuse or, if

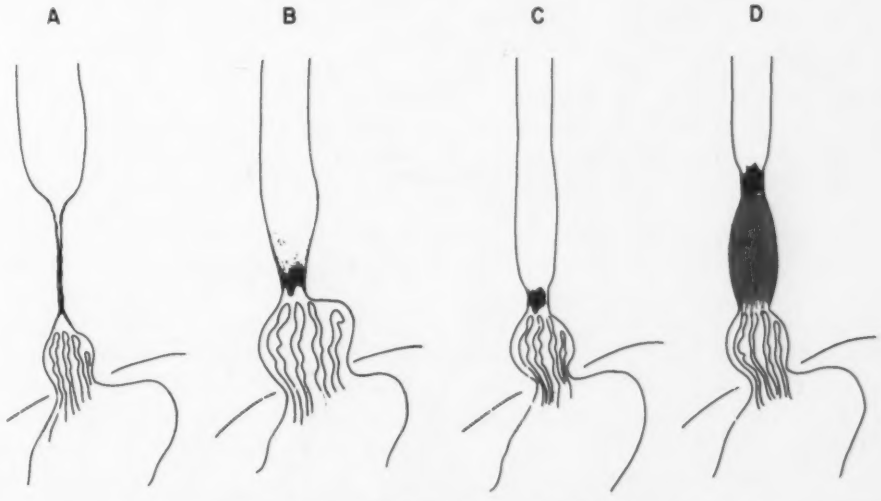


Fig. 1. Diagrammatic representation of types of peptic or reflux esophagitis. (*A*) Severe extensive peptic esophagitis with marked narrowing of long segment proximal to a small hernial sac. There is usually a history of a duodenal ulcer, operation and/or intubation. A pre-existing hernial sac is not a prerequisite. The marked narrowing at the onset is due to spasm and inflammatory exudate but may persist and become fibrotic. (*B*) Diffuse peptic esophagitis of a moderate degree as seen with uncomplicated direct hernias and reflux. Lack of distensibility of minimal degree over a variable distance of distal esophagus. In some cases, superficial ulceration or multiple ulcerations are present in the terminal portion of the esophagus. (*C*) Peptic esophagitis with superficial inflammatory changes with or without erosions or ulceration limited to a short segment of the terminal portion of the esophagus. The involved segment may be quite short and the evident inflammatory changes may not involve the entire circumference. (*D*) In addition to a direct hiatus hernia, the distal esophagus over a distance of several centimeters is lined by cylindric or Barrett type of epithelium. This has been referred to as gastric-lined esophagus or heterotopic gastric mucosa. In this case, however, the inflammatory and ulcerative changes are indicated as being confined to the terminal portion of the squamous-lined part of the esophagus, that is, these changes are noted immediately proximal to the gastric-lined portion of the esophagus which itself shows no evident involvement.

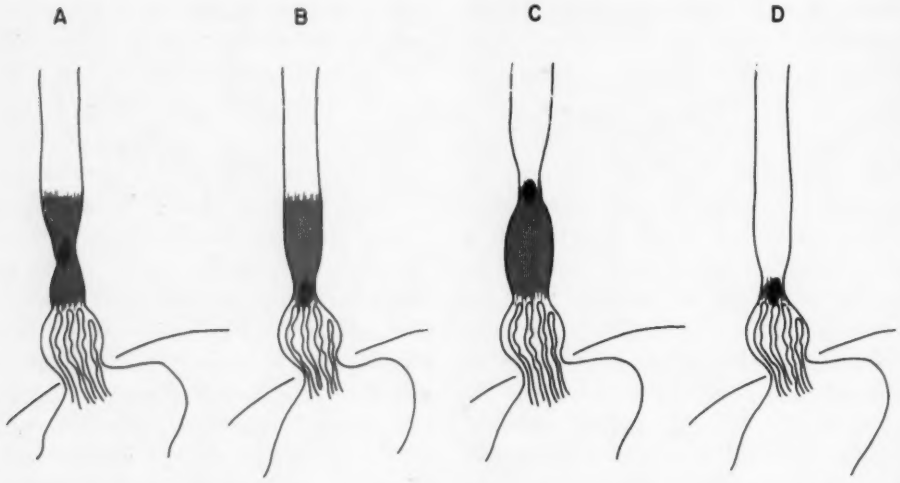


FIG. 2. Diagrammatic representation of types of peptic ulceration in association with gastric-lined esophagus or Barrett epithelium. (*A*) Peptic ulceration within the gastric-lined segment. Moderate narrowing or limited distensibility is usually seen at the level of the ulceration. (*B*) Peptic ulceration at the distal margin of the gastric-lined segment with gastric rugae at its distal edge. (*C*) Peptic ulceration at the proximal margin of the gastric-lined segment or within a region of mixed epithelium, that is, a combination of Barrett and squamous epithelium. An ulceration in this region may be referred to as marginal since squamous epithelium is present at its proximal edge. (*D*) Peptic ulceration in the terminal portion of the esophagus which is lined by mixed epithelium or was the seat of minimal heterotopia or a very short gastric-lined segment of esophagus. This type of case creates difficulty in terminology since at different places about the ulceration there may be found normal gastric epithelium, Barrett epithelium and squamous epithelium. The term "marginal" has also been applied to this type of case. It is essentially similar to the situation diagrammed in *C* except there is no remarkable length of the distal esophagus that is lined by an atypical cylindric epithelium. It is evident that the roentgen findings corresponding to *D* may resemble those corresponding to *B*, as well as those corresponding to *C* in Figure 1. It is, therefore, often necessary to use the term peptic ulceration independent of the nature of the epithelium or until its nature is determined by microscopic examination. Moreover, more diffuse inflammatory changes are often present in the gastric or in the squamous lined segments or in both which obscure the demarcations between individual segments.

not diffuse, at least superficial and poorly demarcated and to speak of peptic ulceration when a discrete, relatively deep or localized ulceration can be demonstrated. In the absence of extensive heterotopia, which can be suspected on roentgen examination, it is likely that the nature of the epithelium is probably of less clinical significance than the depth and persistence of the ulceration and the degree and extent of the associated fibrosis and stricture formation. Roentgenographically, therefore, there are cases of (1) peptic esophagitis of a diffuse nature, either severe or mild; (2) peptic esophagitis or superficial peptic ulceration localized to the terminal portion of the esophagus; (3) peptic ulceration in the terminal portion of the esophagus of discrete nature demonstrable by a niche or a persistent patch of barium; (4) discrete peptic ulceration associated with gastric-lined esophagus. This last group includes those cases in which the degree of heterotopia is of such extent that it may be recognized on roentgen examination and the distance between the ulceration and the true hernial sac may then also be indicated. The third group includes those cases where, if heterotopia is present at all, it is of such minimal degree that it is difficult to recognize by roentgen examination and requires microscopic study to establish its presence.

ROENTGEN FINDINGS

Peptic esophagitis is the most common nonspecific inflammatory condition of the esophagus. As already noted, the severe diffuse type is usually the result of intuba-

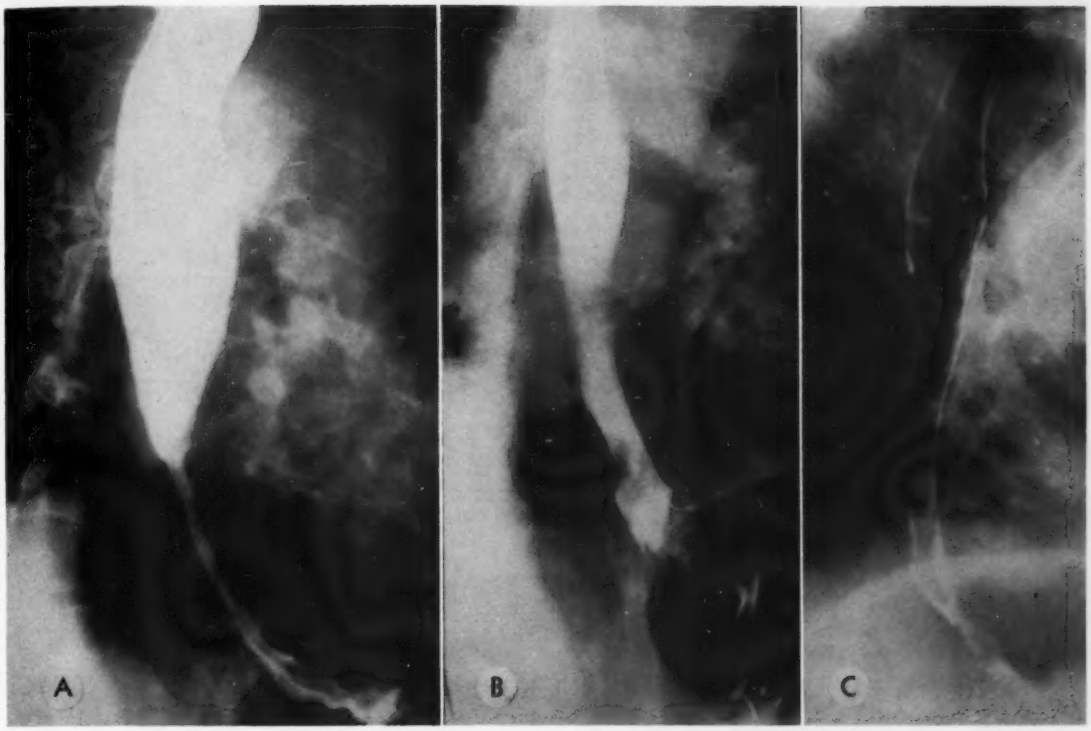


Fig. 3. Severe extensive peptic esophagitis after operative intervention for duodenal ulcer and postoperative intubation. (*A*) Marked narrowing with effaced mucosal pattern over a long segment of the distal esophagus with tapering proximal margin into moderately dilated esophagus. (*B*) Six months later after treatment with bougienage. The patient was markedly improved clinically but there was still limited distensibility of the previously markedly narrowed segment. (*C*) Same as *B*. The continuous column of air confirms the lack of distensibility. (Reproduced by permission of *Gastroenterology*.)

tion or operation or occasionally persistent vomiting and is frequently associated with a duodenal ulcer. A mild diffuse type is seen in association with a hiatus hernia and regurgitation. In the first group, the "tube" type, there may have been no pre-existing abnormality in the esophagogastric region or at the diaphragmatic hiatus (Fig. 3). On careful observation, there is frequently demonstrable a small, oval, sac-like dilatation above the hiatus—perhaps the result of traction secondary to longitudinal spasm of the inflamed esophagus. In other cases of the tube variety, an obvious pre-existing hernia of considerable size is present (Fig. 4). Roentgen examination in this severe form of diffuse peptic esophagitis shows a long, somewhat straightened segment involving 5 to 10 cm. of the distal esophagus which is markedly narrowed with irregularly serrated and indistinct contours. Proximally, the esophagus is moderately dilated and characteristically joins the narrowed segment in a fairly abrupt tapering fashion. No large niche or projecting ulcer crater is present. The mucosal pattern within the narrowed segment is markedly distorted or effaced (Fig. 5). Small, irregular, tertiary contractions may be noted within the narrowed segment and its caliber may vary slightly from day to day.

The roentgen findings in the severe or tube variety of peptic esophagitis are in marked contrast to the findings in the usual case of peptic esophagitis associated with a sliding hernia. It has been stated that esophagitis occurs in half to three-quarters of cases with sliding hernia as demonstrated by esophagoscopy and that roentgen findings are frequently absent in such cases. It is certainly unusual to find unequivocal roentgen evidence of esophageal inflamma-

FIG. 4. Duodenal ulcer, gastroenterostomy and postoperative intubation; severe extensive peptic esophagitis in a patient with a pre-existing direct hiatal hernia of considerable size. This is in contrast to the patient shown in Figure 3 in whom there is no evidence of any remarkable hiatus hernia.

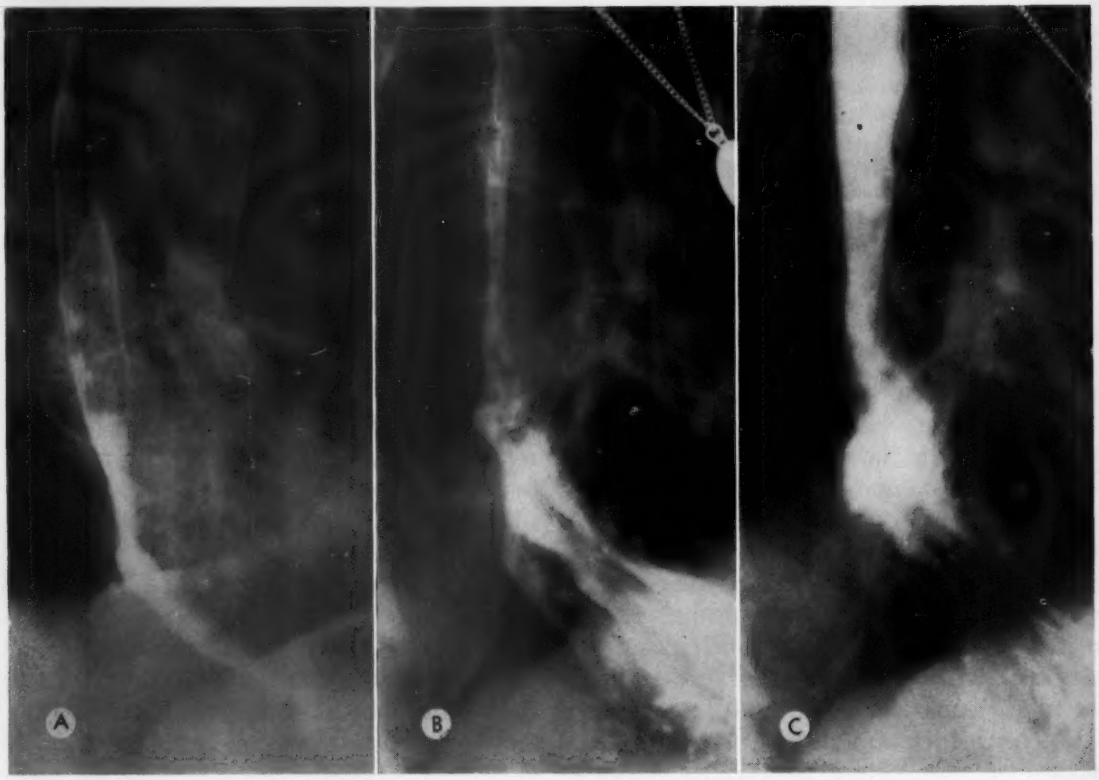


FIG. 5. Duodenal ulcer in a patient having occasional vomiting. Moderately severe extensive peptic esophagitis. There is a persistent lack of distensibility in the distal portion of the esophagus; the esophagus shows a lack of the normal curvatures; the patient swallowed barium and air so that roentgenograms of complete filling could not be obtained. A moderate size hiatus hernia is evident in the recumbent roentgenograms, *B* and *C*. It is also present and apparently of the same length in the erect position as shown in *A* but the hernial sac is elongated and does not distend. This complete lack of mobility suggests but does not prove the presence of an associated mediastinitis. (Reproduced by permission of *Gastroenterology*.)

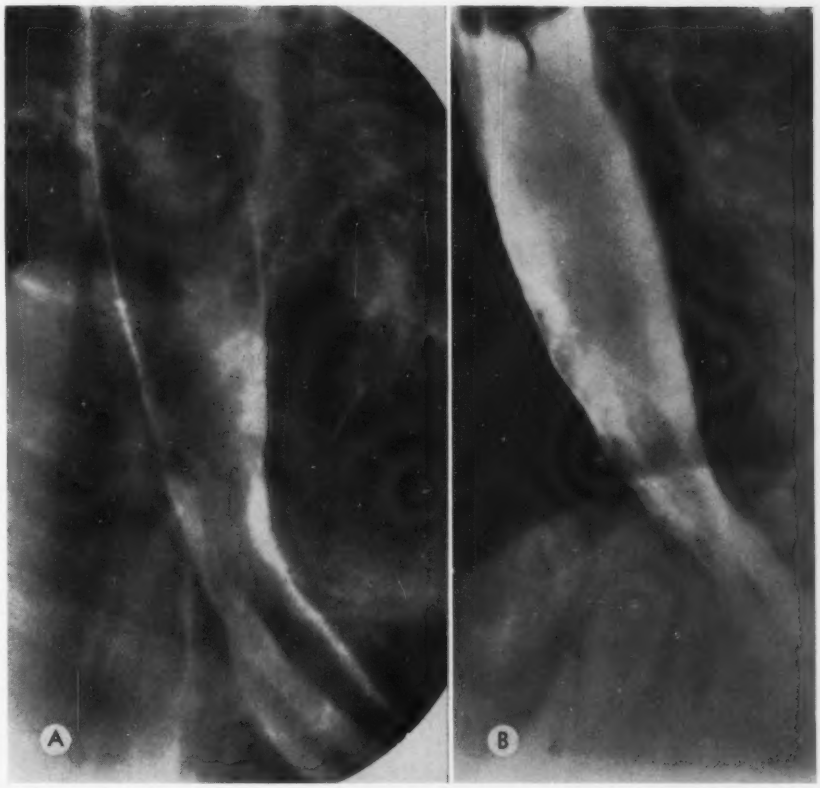


Fig. 6. (*A* and *B*) Small direct hiatus hernia with free reflux. There is a minimal moderately extensive peptic esophagitis demonstrated by a slight rather subtle lack of complete distensibility in the terminal portion of the esophagus, a straight course and straight margins of the esophagus, with slight funneling distally into the hernial sac. Filling of the entire esophagus and hernial sac in a continuous air column is more easily obtained in such patients and is a good test of distensibility.

tion in patients with sliding hernias despite the presence of free regurgitation. It is not uncommon, however, to find minimal abnormalities that suggest the presence of a mild esophagitis and these appear to be essentially the result of functional disturbances. In some instances, the esophagus for a variable distance proximal to the esophagogastric junction may be incompletely distensible in the sense that the contours remain straight with slight funneling distally (Fig. 6). The usual smooth curvatures of the esophagus are obliterated and the esophagus may appear taut. These patients have difficulty in drinking barium rapidly and continuously and swallow quantities of air at the same time. It is, therefore, difficult to obtain roentgenograms of the esophagus showing complete filling. The peristaltic stripping action at the end of swallowing is inefficient, leaving behind a mottled, irregular column of barium. Barium fails to adhere to the esophageal contours or to outline distinct linear folds. Occasionally, it may be possible to demonstrate a distorted or thickened surface pattern in the partially collapsed esophagus. Persistent or recurring segmental contraction of the distal portion of the esophagus may be present (Fig. 7) and irregular tertiary contractions are frequent. With satisfactory roentgenograms in multiple projections, it may be possible to recognize that inflammatory changes do not extend around the entire circumference (Fig. 8 and 9).

In the later stages of peptic esophagitis, particularly in the severe type, fibrotic stenosis or stricture may occur in the distal esophagus. When the stricture is very

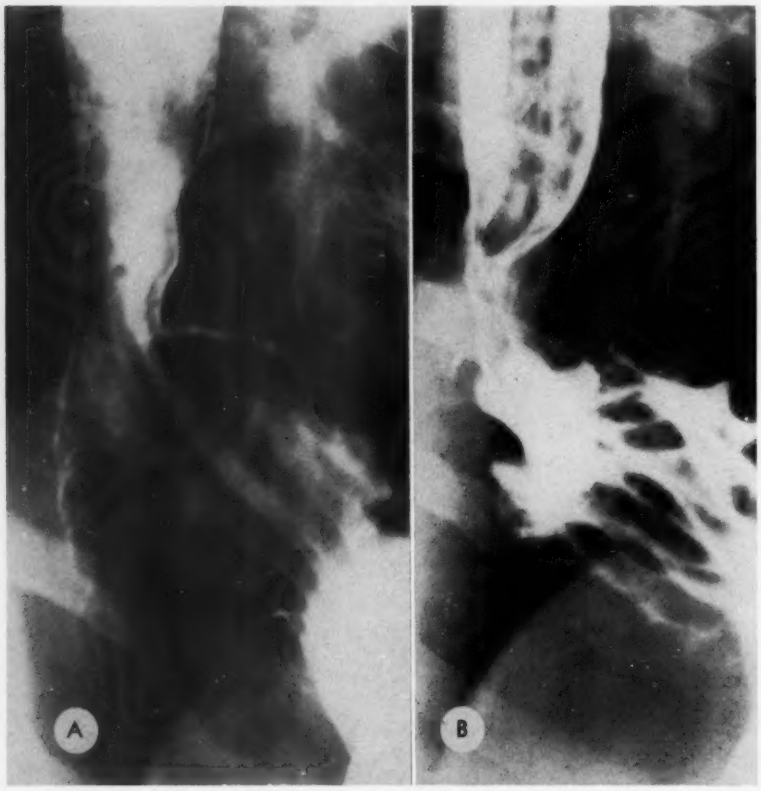
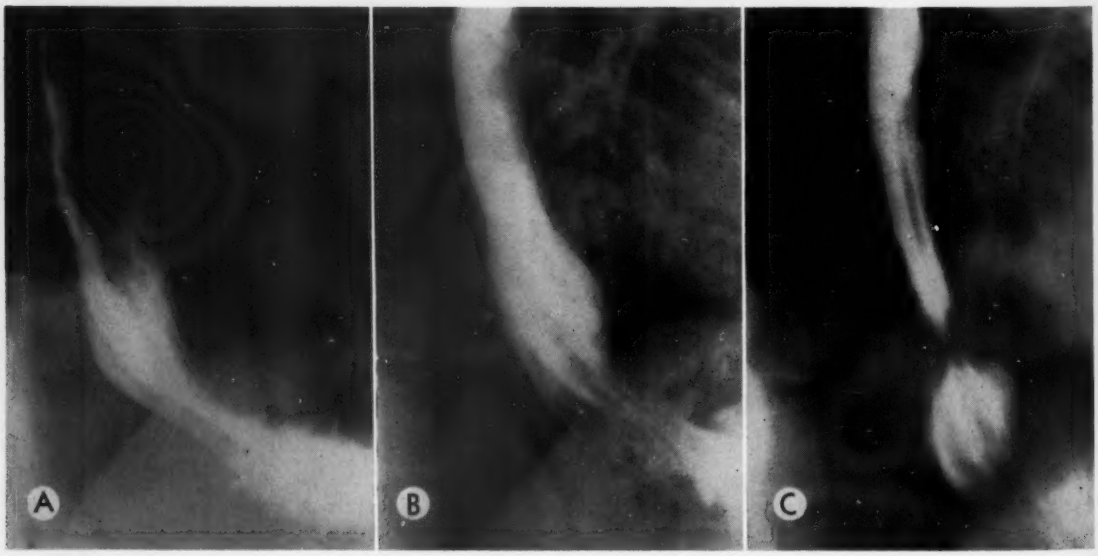


FIG. 7. Peptic esophagitis of minimal degree and extent associated with a moderate size hiatus hernia and free reflux. (*A*) Roentgenogram shows limited distensibility over the distal 2 or 3 cm. of the esophagus as demonstrated by "double contrast" study. (*B*) Roentgenogram shows the recurring unusually long segmental contraction in the terminal esophagus which may be referred to as spastic in character even though the complete lumen of the esophagus is not obliterated. A very flat crescentic patch of barium is seen on the posterior wall immediately proximal to the contracted segment. Superficial ulceration was confirmed at esophagoscopy in this region. Incidentally, re-examination after a period of four years of medical therapy showed no remarkable change in the roentgen appearance. (Reproduced by permission of *Gastroenterology*.)



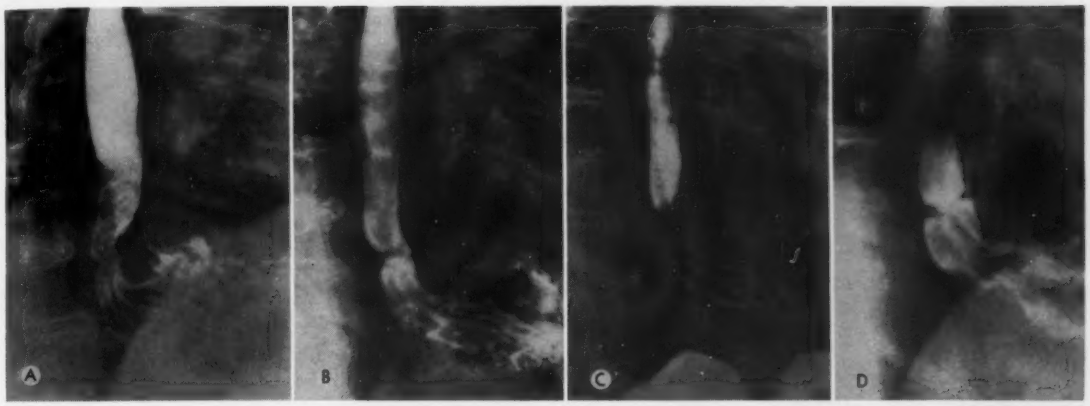


Fig. 9. Peptic esophagitis of minimal degree and extent. A small direct hiatus hernia is present but no reflux could be demonstrated in either the Johnstone or Trendelenburg positions. (*A*) Limited distensibility and irregularity in filling of the terminal portion of the esophagus with faint spiculation on its anterior margin immediately proximal to the esophagogastric junction. (*B*) This was the best filling that could be obtained of the esophagogastric region and demonstrates a persistent flattening on the anterior wall in this area with a lucent band traversing the column of barium at this site ending in a notch posteriorly. (*C*) Localized segmental contraction which recurred in the terminal portion of the esophagus. (*D*) Maximum distention of the esophagogastric region with air and barium shows bilateral notching with a somewhat hazy lucent band between the notches. The exact location of this ring is not known but the functional phenomena and the mucosal pattern suggest that it is probably immediately proximal or at the esophagogastric junction. At esophagoscopy in this patient, the presence of minimal esophagitis was confirmed. There was no free reflux of gastric contents into the esophagus but this did occur in intermittent fashion.

marked (1 or 2 mm.), it is usually quite short (Fig. 10) and may occur not at the esophogastric junction but 2 or 3 cm. proximal to it. Less marked short strictures appearing only as a collar or ring which do not distend to the normal caliber of the esophagus (Fig. 11) may also occur immediately proximal to the esophagogastric junction.[5] The esophagus proximal to a stricture shows moderate dilatation which does not reach the extent seen in severe cardiospasm. In association with a stricture, there is often chronic or recurrent ulceration which may be difficult or impossible to recognize on roentgen examination.

DISCRETE PEPTIC ULCERATION IN THE TERMINAL ESOPHAGUS

The roentgen findings in marginal ulceration have been previously described in detail[12] and were classified in nonstenotic and stenotic phases (Fig. 12 and 13). The transformation from the nonstenotic stage to marked stenosis has now been observed so there appears to be no fundamental difference between these two types. The presence of discrete ulceration is frequently easier to recognize in the absence of marked stenosis since it may be demonstrable as an ulcer patch. When severe narrowing is present and associated with the ulcer, the recognition that discrete ulcera-

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Fig. 8. Minimal peptic esophagitis in association with a small direct hernia. (*A*) The posterior margin of the esophagus about 3 cm. above the hiatus is irregularly outlined and does not distend as well as the adjacent portions. Rather thick longitudinal folds are seen beyond this level extending through the hiatus. (*B*) More complete filling obscures the eroded area seen in *A* and demonstrates the numerous somewhat tortuous folds traversing the hiatus. (*C*) A short segmental or localized area of contraction in approximately the region of the erosion which may represent the region of the so-called inferior esophageal sphincter displaced a short distance proximally. This finding as well as the fold pattern distal to it and evidence of widening of the hiatus confirm the presence of a small direct hernia. Incidentally, only minimal reflux could be demonstrated in this patient despite straining in the Johnstone or bent-over position. The findings described above were confirmed on esophagoscopy. (Reproduced by permission of *Gastroenterology*.)

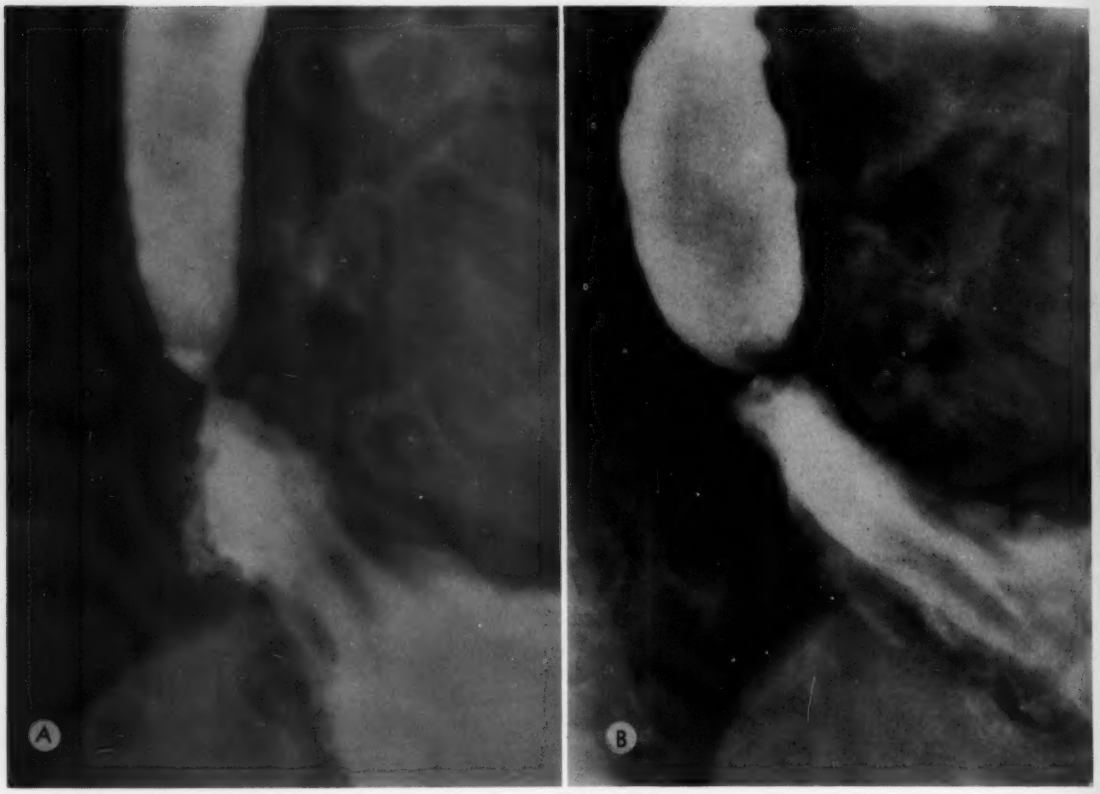


FIG. 10. Severe short stricture due to peptic esophagitis in a patient with history of duodenal ulcer. (*A*) Stricture 2 or 3 mm. in length and 2 or 3 mm. in width with amorphous appearance of the barium in the narrowed segment. (*B*) Better filling shows excessive distensibility of the esophagus proximal to the stricture, a small circular lucent defect (foreign body?) above the stricture and a small circular patch of barium immediately beyond the stricture with a thick transverse somewhat curvilinear fold distal to the small crater. Esophagoscopy followed by resection indicated that the stricture was located about 2 cm. proximal to the esophagogastric mucosal junction. Between the stricture and this junction, a chronic peptic ulcer was found in squamous epithelium.

tion is present must be made by the demonstration of the effaced mucosal pattern over the short, narrowed segment, that is a "slit-like" ulcer is visualized (Fig. 14). It is difficult to estimate the extent of fibrosis associated with such strictures since a considerable part of the narrowing may be spastic in nature or the result of inflammatory exudate in the wall of the esophagus. It has been pointed out above that the ulceration in at least some of these cases has apparently occurred in Barrett type of epithelium.

PEPTIC ULCERATION AND GASTRIC-LINED ESOPHAGUS

The roentgen findings of discrete ulceration are the same as those in the absence of a gastric-lined segment. It, however, may be evident that the ulcerated area or the associated stenosis is located at some distance above the neck of a typical hernial sac. A typical picture (Fig. 15) consisting of three segments may be present in some cases:[4] (1) the normal esophagus separated from (2) an intermediate segment by a short stenotic region and (3) the pouch-like hernial sac with the cardia at its apex. The intermediate segment may be more distensible than the normal esophagus so that the three segments may also show a step-wise increase in caliber. In other instances, the intermediate segment remains tubular (Fig. 16). If a discrete ulceration is unusually deep or if a sealed-off perforation is suspected (Fig. 17), it is likely that

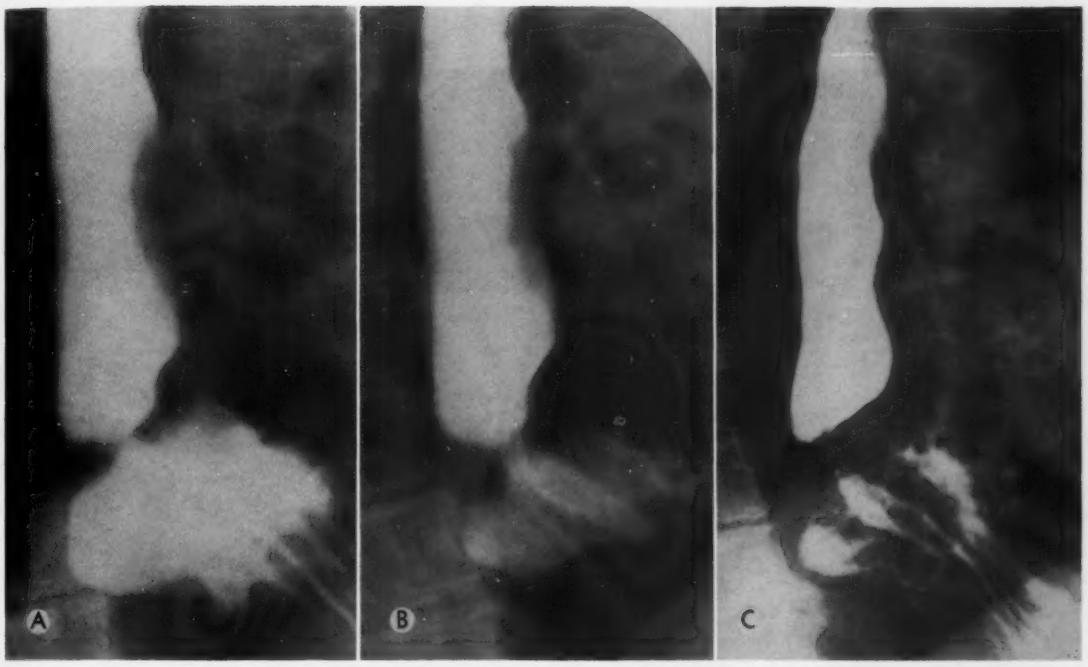


FIG. 11. Short collar-like persistently narrowed segment immediately proximal to the esophagogastric mucosal junction presumably the result of healed esophagitis. (*A*) Roentgenogram shows the lack of distensibility over a short segment with slight if any dilatation of the esophagus proximal to it. (*B*) Roentgenogram demonstrates the constancy of this finding. (*C*) Roentgenogram indicates the ability of the narrowed segment to contract completely with, at times, some delay in relaxation with transient hold-up of the barium column. There was no history or evidence of a duodenal ulcer in this patient. At esophagoscopy, there was little if any evidence of esophagitis but the narrowing proximal to the esophagogastric mucosal junction required periodic mechanical dilatation.

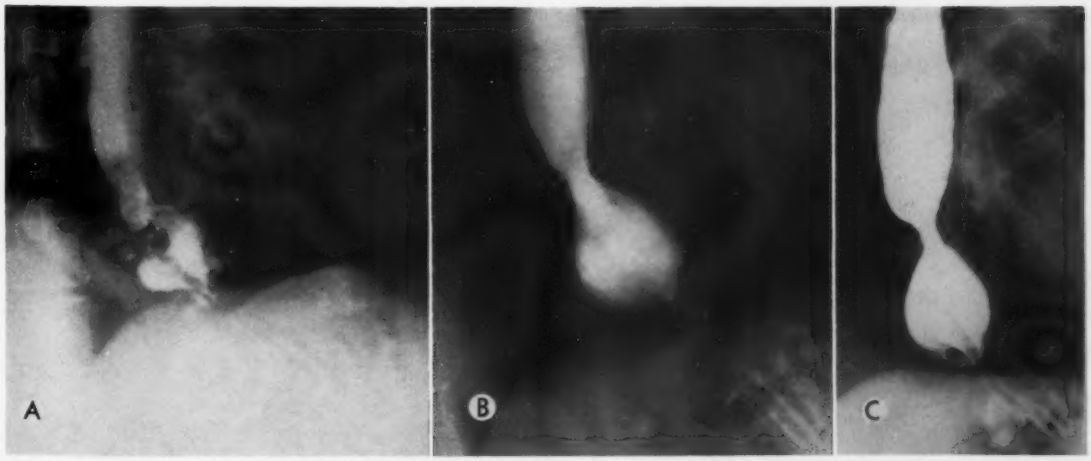


FIG. 12. Discrete peptic ulceration in the terminal portion of the esophagus. (*A*) Roentgenogram shows a large persistent patch of barium immediately proximal to the esophagogastric junction. The fact that a discrete patch can be visualized and that there is a faint ring surrounding it is indicative of ulceration deeper than a simple "erosion" of the epithelium. (*B*) Despite maximum filling, the terminal esophagus does not distend completely; the patch is faintly visible through the barium column. (*C*) One and a half years later, a moderately constricted, short segment persists at the site of the previously demonstrated ulceration. The patient was treated with mechanical dilatation. Biopsy in this patient showed fragments of esophageal and gastric mucosa, the *latter* showing small areas of necrosis. This suggests that the ulceration visualized may have occurred in a Barrett epithelium. There was no evidence either on roentgen examination or on esophagoscopy of any extensive gastric-lined segment of the esophagus but multiple biopsies at numerous levels were not taken. (*A* and *B* reproduced by permission of *Radiology*.)

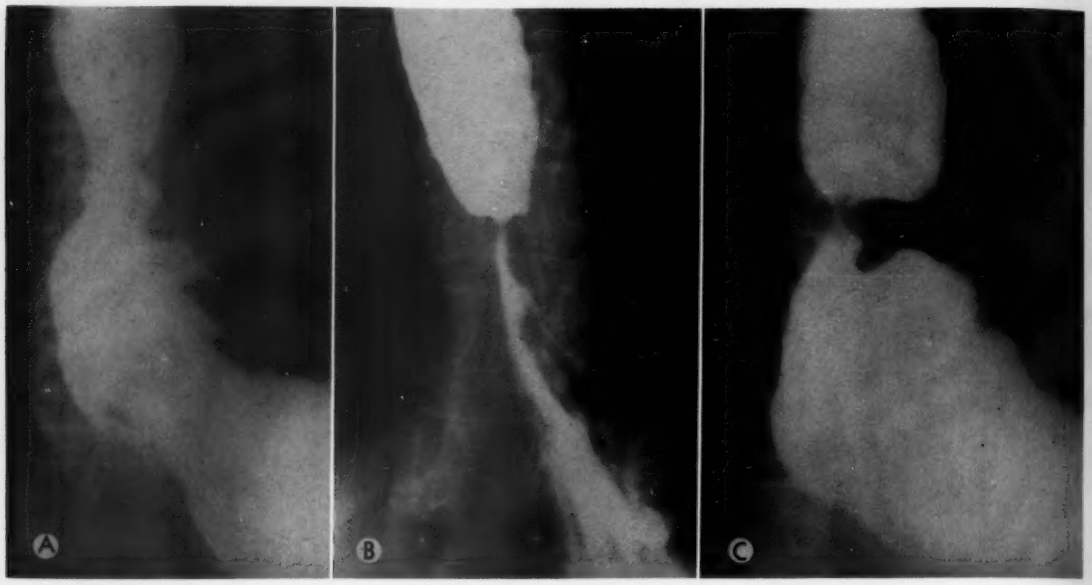
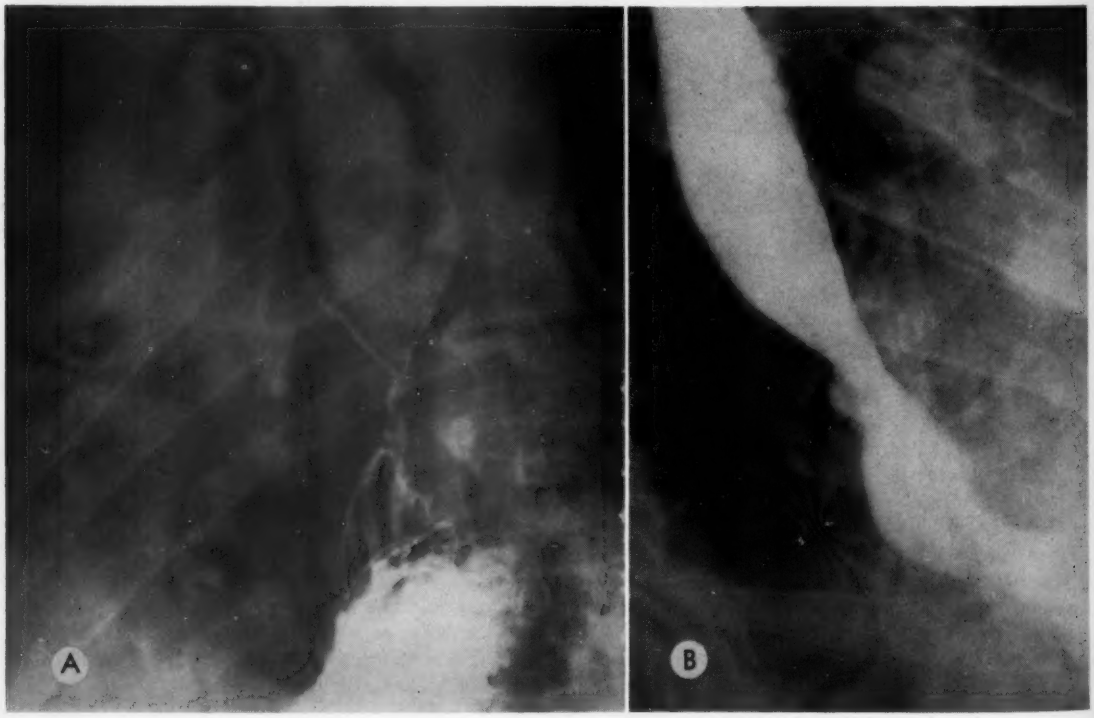


FIG. 13. Peptic ulceration in the terminal portion of the esophagus. (*A*) Limited distensibility in the terminal portion of the esophagus with a projection which is present on both the left and posterior aspects. This roentgenogram was taken supine during free regurgitation. On esophagoscopy at this time, an ulceration 2 cm. long which completely encircled the lumen along its distal edge was found 34 cm. from the incisor teeth. Despite the fact that the lumen appeared to be normal in caliber on roentgen examination, the esophagogastric junction distal to the ulceration appeared markedly narrowed at esophagoscopy to about 6 mm. Biopsies showed inflamed squamous epithelium with superficial peptic digestion. (*B*) Two years later, there was marked stenosis at the site of the previous ulceration. On esophagoscopy, a pinhead-sized stricture was seen 32 cm. from the incisor teeth. (*C*) Same examination as in *B* with pateint supine, showing free reflux into the esophagus and marked distention of the hernial sac. Distention of the sac to this degree could not be obtained during the swallowing of barium. (Reproduced by permission of *Gastroenterology*.)



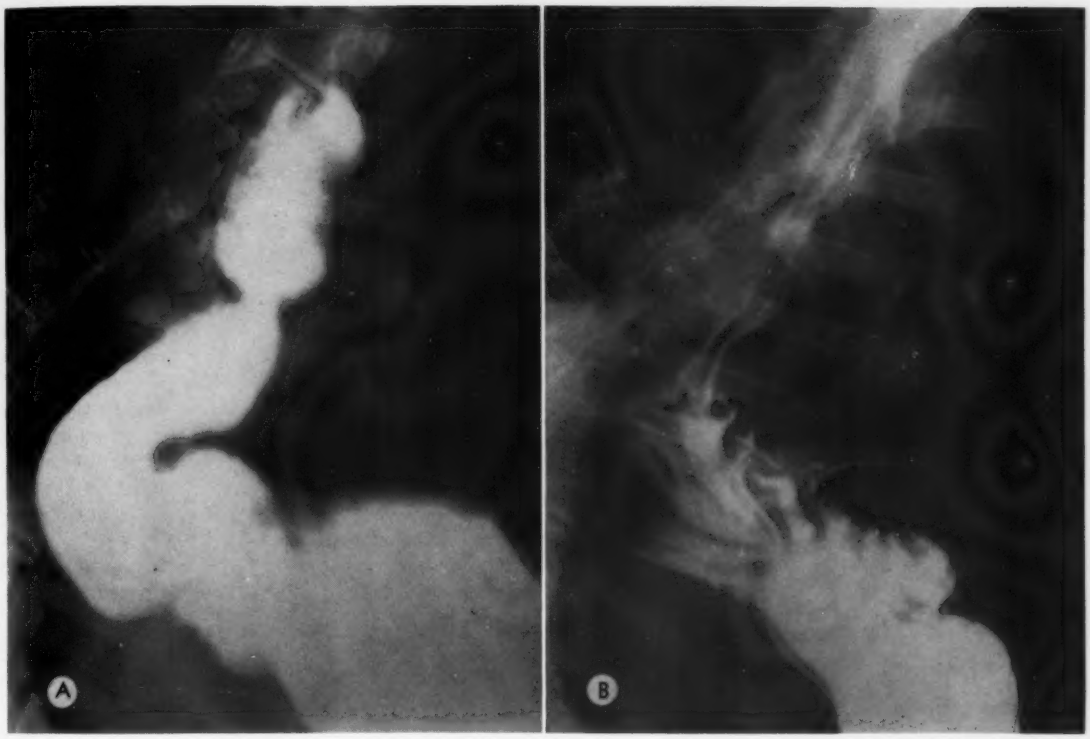


Fig. 15. Peptic ulceration in gastric-lined esophagus. (*A*) The patient has a marked kyphoscoliosis. There is a rather globular pouch in and above the hiatus of the diaphragm with a broad communication to a rather unusually distensible esophagus. Within the esophagus well above the pouch, there is a ring-like narrowing. (*B*) Less complete filling demonstrates a patch of barium at the site of the ring-like narrowing. The transition between the tubular esophagus and the globular herniated sac is evident. At esophagoscopy, inflammatory changes were noted beginning 25 cm. from the incisor teeth. A moderately marked narrowing of the lumen was noted at 30 cm. which could be passed by the esophagoscope without difficulty. Biopsies both proximal and distal to the area of narrowing showed "gastric mucosa." (Reproduced by permission of *Gastroenterology*.)

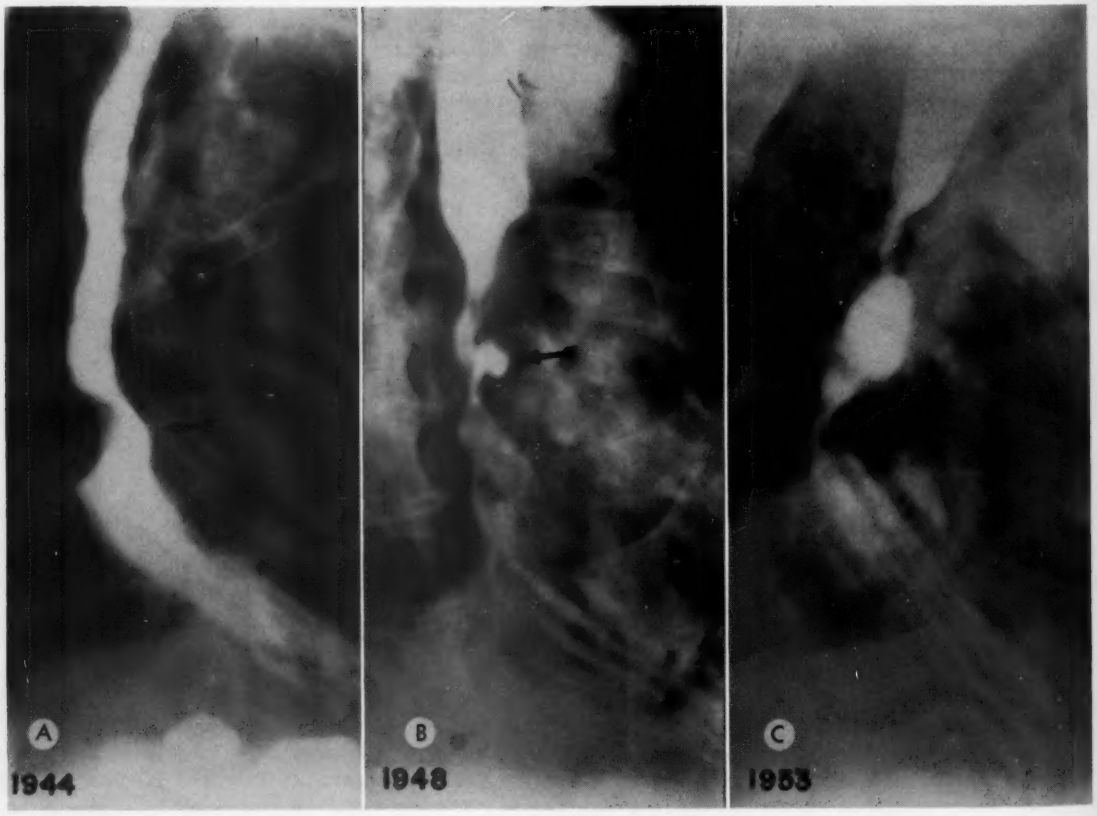
the ulceration has occurred in a Barrett type of epithelium. It must be noted that a gastric-lined esophagus may also develop diffuse inflammatory changes which will then resemble the changes seen in peptic esophagitis of the usual variety (Fig. 18).

DIFFERENTIAL DIAGNOSIS

It is essential that carcinoma of the esophagogastric region not be mistaken for peptic esophagitis or peptic ulceration. In a typical case (Fig. 19), the gross irregularity, the complete rigidity, an abrupt margin convex toward the lumen, or the filling defect extending into the stomach permit the diagnosis of carcinoma without difficulty. In other instances, however, the carcinomatous infiltration may be superficial (Fig. 20) or manifest itself predominantly as a flat ulcer (Fig. 21) or produce

Fig. 14. Peptic ulceration in the terminal esophagus. (*A*) The terminal portion of the esophagus is markedly strictured and the mucosal pattern within the stricture is effaced, indicative of ulceration. Esophagoscopy showed a discrete ulceration covered by whitish membrane as well as narrowing of the lumen beginning at 30 cm. from the incisor teeth and extending distally for 5 cm. Biopsies at 30 and at 35 cm. on two different occasions showed inflamed cardiac type of gastric epithelium without any evidence of squamous epithelium. The patient was treated with bougienage. (*B*) Examination four years later shows minimal narrowing in the terminal esophagus but there is a niche-like crater projecting from the posterior wall. The patient was re-examined at this time because of hematemesis and had had surprisingly few complaints in the interim. (*A* reproduced by permission of *Radiology*.)

FIG. 16. Chronic peptic ulceration associated with gastric-lined esophagus. A short marked stricture is present immediately below the level of the arch of the aorta. The esophagus proximal to the stricture is moderately dilated while the esophagus distal to the stricture maintains a tubular configuration. At esophagoscopy, an ulceration was seen 30 cm. from the incisor teeth. The lumen at the level of the ulceration was narrowed but was passed without difficulty and the mucosa visualized beyond the stricture was intensely hyperemic. Biopsy at 30 cm. from the incisor teeth showed fragments of gastric mucosa and a fragment of chronically inflamed fibrous tissue as seen in the bed of a peptic ulcer. Biopsy at 34 cm. also showed only gastric mucosa. The biopsy findings in this case suggest that the ulceration noted on esophagoscopy at the site of the stricture seen on roentgen examination had arisen in Barrett type of epithelium. It would ordinarily be anticipated that a marked stricture such as that seen on roentgen examination would be located in squamous epithelium. The fact that the stricture could be passed with little difficulty on esophagoscopy suggests that there was a considerable element of spasm at the time of the roentgen examination. (Reproduced by permission of *Radiology*.)



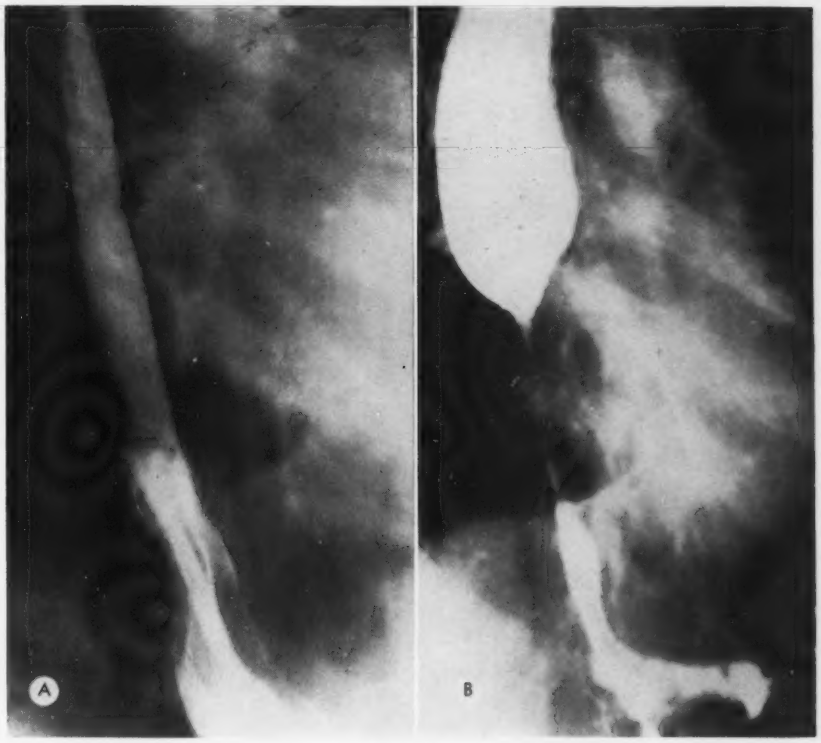


Fig. 18. Duodenal ulcer, gastroenterostomy, intubation. Severe extensive esophagitis of peptic origin in gastric-lined esophagus. (*A*) Roentgenogram of the esophagus taken prior to gastroenterostomy shows a small hiatus hernia but is otherwise not remarkable. (*B*) Postoperatively, following removal of an indwelling suction tube, the patient developed marked dysphagia. Re-examination showed severe extensive stenosis with effacement of the mucosal pattern in the distal esophagus. Esophagoscopy demonstrated circumferential ulceration of superficial character beginning at 33 cm. from the incisor teeth. At 35 cm., a pinhead-sized stenosis was visualized. Biopsy taken 1 cm. above the stricture showed gastric mucosa with peptic necrosis and digestion. Biopsy taken 1 cm. distal to the stricture showed normal gastric mucosa. (Reproduced by permission of *Gastroenterology*.)

Fig. 17. Peptic ulceration in gastric-lined esophagus. This patient was followed periodically over ten years during which time six biopsies taken at various distances 25 to 35 cm. from the incisor teeth showed only gastric epithelium. (*A*) 1944. This examination was done several months after mechanical dilatation and shows slight limitation of distensibility of the terminal portion of the esophagus with a somewhat hazy appearance of the barium column suggesting the possibility of superficial ulceration (arrow). The remainder of the esophagus shows limited distensibility and somewhat spiculated contours. (*B*) 1948. There is a deep pseudodiverticular ulcer crater, the configuration of which suggests that there may have been a sealed-off perforation or penetration. Marked narrowing is present for a short distance distal to the crater, while proximal to it over a distance of several centimeters there is moderate narrowing with lack of distensibility of the lumen of the esophagus. The mucosal pattern proximal to the crater is indistinct. (*C*) 1953. An intermediate segment of moderate distensibility with short narrowed segments both proximally and distally is visualized. The crater previously seen was not filled. The proximal narrowing is presumably in squamous-lined esophagus and defines the proximal extent of the gastric-lined portion of the esophagus. This patient came to autopsy because of another condition and showed severe, diffuse inflammatory changes in a gastric-lined segment of esophagus as well as in the more proximally located normally lined esophagus. A sealed-off perforation was present at the esophagogastric margin. This case has been previously described in detail.[12] (*B* and *C* reproduced by permission of the *Journal of the American Medical Association*.)

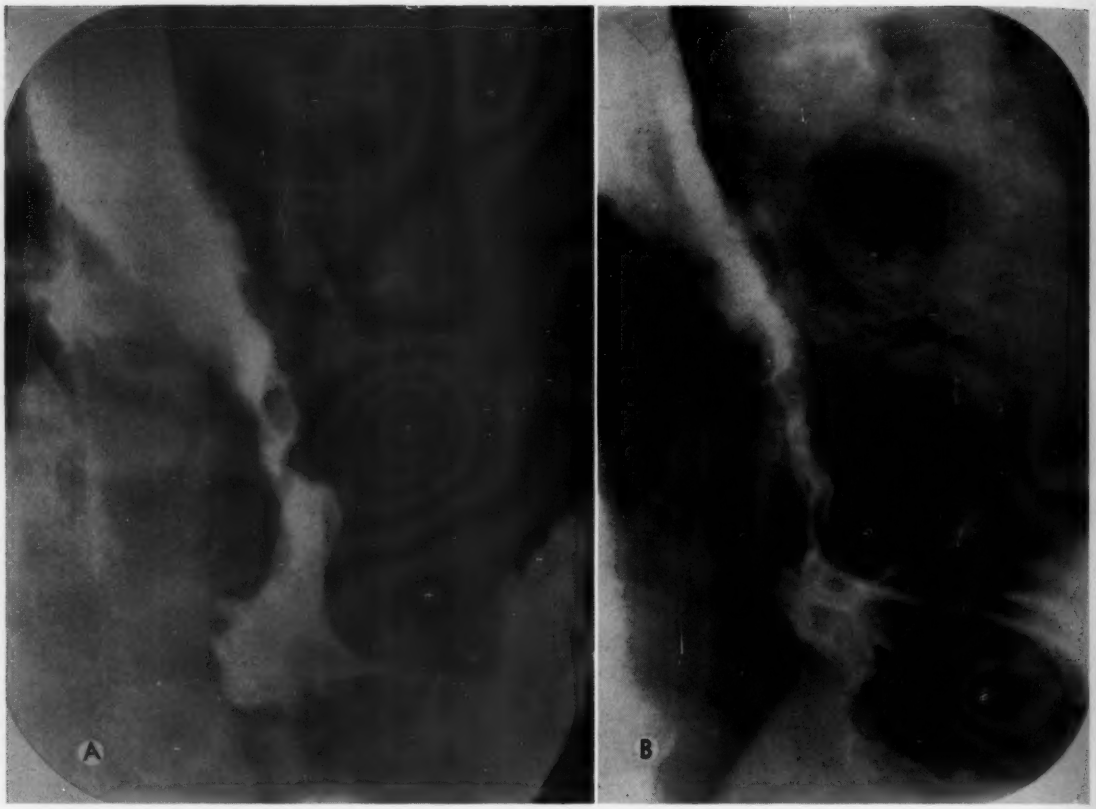
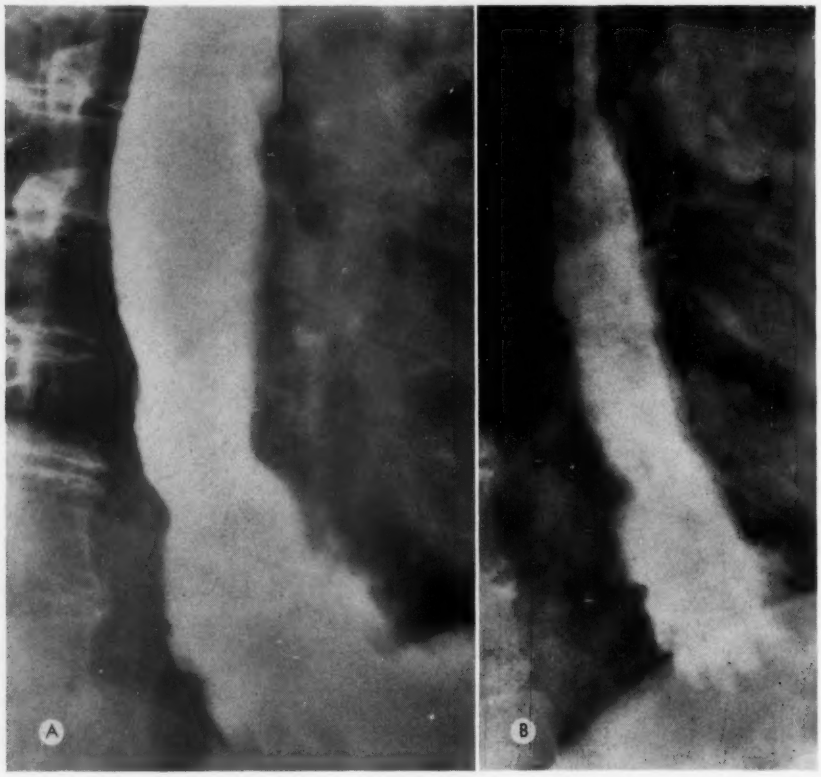


FIG. 19. Adenocarcinoma of the distal esophagus and the hernial sac. (*A*) Rigid irregular contours with moderate narrowing and multiple small filling defects in the esophagogastric region. Jagged margins of the esophagus proximal to this area for a considerable distance. (*B*) Destroyed mucosal pattern.



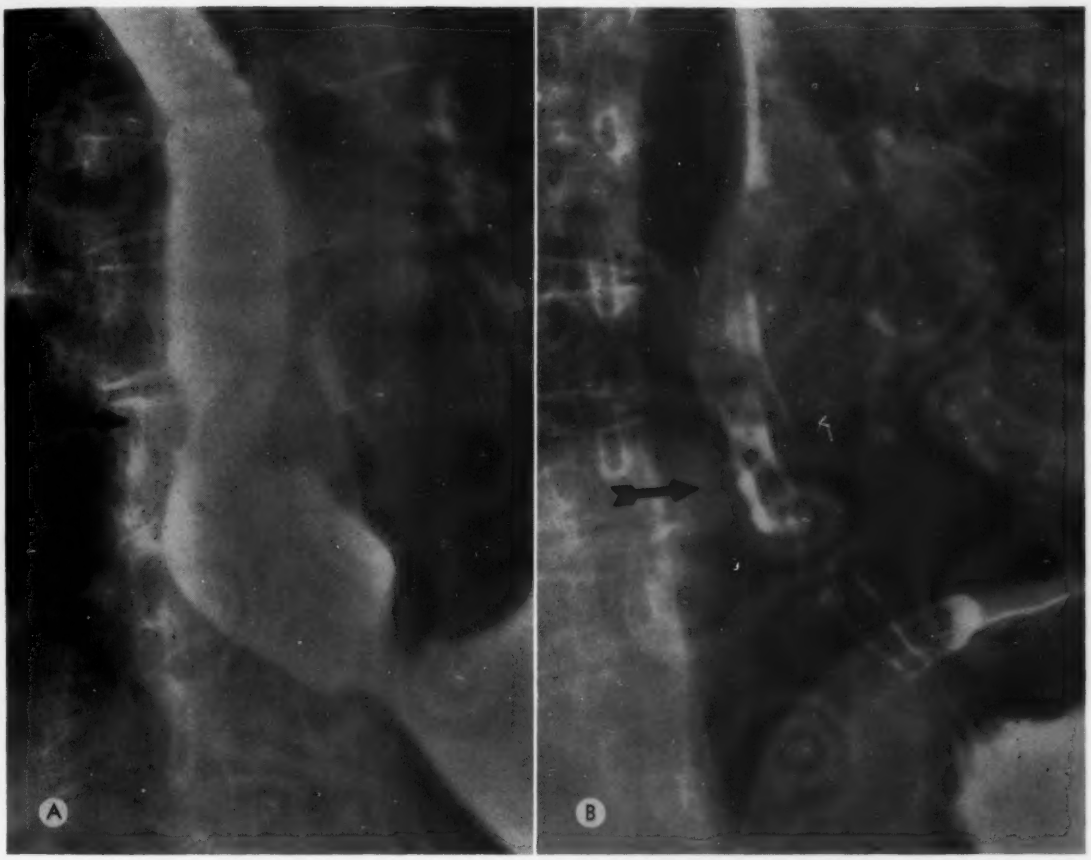


Fig. 21. Adenocarcinoma in the esophagogastric region. (*A*) Faint indentation on the right wall of the esophagus above a small hernial sac. (*B*) Irregular elongated ulcer crater with small filling defects in its center and a faintly demarcated circumferential elevated margin. This was a malignant ulcer.

such marked stenosis that adequate study is not possible. In any doubtful case, the diagnosis of peptic esophagitis must not be made without confirmation by esophagoscopy and biopsy.

In the rare case of an ectopic island of gastric mucosa in the distal esophagus, deep ulceration in the adjacent squamous epithelium may occur as seen more commonly in a Meckel's diverticulum containing such an island. Peptic ulceration may also follow esophagogastrostomy or forceable dilatation of the cardia and hiatus during treatment of cardiospasm. Peptic esophagitis usually of minimal degree is also seen as a complication of scleroderma or dermatomyositis involving the esophagus, presumably also the result of reflux and minimal herniation. In so-called "chalasia" in newborns or "gastroesophageal relaxation" in adults, free reflux and esophagitis may occur. It is likely that some degree of hiatal herniation is present in many of such cases. Scirrhous carcinoma of the cardia

←

Fig. 20. Superficial spread of adenocarcinoma of the esophagogastric region. (*A*) No limitation in distensibility but the contours of the filled esophagus and proximal portion of the hernial sac are somewhat jagged and serrated. (*B*) With less distention, there appears to be a rather flat defect along the posterior wall of the esophagus proximal to the hernial sac. The presence of carcinoma in the resected specimen could hardly be recognized grossly but microscopically there was extensive infiltration of the mucosa of both the esophagus and the stomach.

may be associated with reflux, but gross esophagitis is unlikely because of the short course and low acidity.

SUMMARY

1. Peptic esophagitis usually of mild degree is frequently present in association with a hiatus hernia of the direct variety. The roentgen findings in such cases may be minimal. In the presence of a duodenal ulcer or excessive gastric acidity and hypersecretion for some other reason, or as a result of intubation and operative intervention under general anesthesia, peptic esophagitis of severe degree involving a considerable portion of the distal esophagus may occur and may result in marked stricture formation.

2. A group of patients exists in whom a variable length of the distal esophagus is lined by an atypical or embryonic or heterotopic (Barrett) type of epithelium. This type of epithelium is also susceptible to inflammation and ulceration, presumably under the influence of acid gastric juice regurgitated from a hernial sac of (true) stomach. An ulceration in such a gastric-lined segment of esophagus may resemble an ordinary chronic peptic ulcer as seen in the stomach. A review of cases of chronic peptic ulcer of the esophagus previously reported indicates, according to Barrett, that they have been encountered in association with this developmental anomaly of the lining epithelium of the distal esophagus which went unrecognized. This author, therefore, suggested that the term "chronic peptic ulcer" of the esophagus be restricted to this type of lesion. Other authors have used the term "Barrett ulcer" for the connotation of the same lesion.

3. In the absence of an inflammatory complication, the presence of a gastric-lined segment of the esophagus is not recognizable by roentgen methods and may also be overlooked at esophagoscopy. When discrete ulceration and/or stenosis is observed by these methods at some distance proximal to a typical hernial sac, the presence of a gastric-lined segment should be suspected. In such instances, the exact location of the ulceration or stricture, *i.e.*, whether it lies within the gastric-lined segment *per se* or immediately proximal to this segment in normally or squamous-lined esophagus, must be determined by microscopic examination.

4. In the presence of a direct hiatus hernia, peptic ulceration of discrete nature may occur in and be localized to the terminal portion of the esophagus without remarkable diffuse involvement of the distal esophagus and independent of gastric hyperacidity.

5. When discrete ulceration is present in the terminal portion of the esophagus in association with a hiatus hernia, the possibility that a Barrett type of epithelium may be present must be kept in mind since (1) ulceration may occur at the distal margin of the gastric-lined segment and (2) the terminal portion of the esophagus may be lined by a mixture of squamous and Barrett type of epithelium for a short distance immediately proximal to the (true) stomach.

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The authors wich to thank *Gastroenterology* for permission to republish Figure 3, 5, 7, 8, 13, 15 and 18; *Radiology* for Figure 12*A*, 12*B*, 14*A* and 16; *J.A.M.A.* for Figure 17*B* and 17*C*.

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STUDIES OF ESOPHAGEAL VARICES BEFORE AND AFTER PORTACAVAL SHUNTS*

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FOR the past several years roentgenographic studies for varices of the esophagus in a group of cirrhotic and noncirrhotic patients have been in progress at The New York Hospital. That part of this study which is pertinent to this presentation concerns a group of 68 patients who had roentgenologic examination for esophageal varices before and after a venous shunt for portal hypertension. Fifty-seven patients had a portacaval shunt, 9 patients a splenorenal shunt and 2 patients a shunt utilizing smaller mesenteric veins. Esophageal findings were correlated with portal pressure changes and postoperative course.

Before analyzing the results of these studies, a few comments concerning the conduct of the roentgen examination would seem relevant.

The ability to obtain a good mucosal pattern of the distal esophagus is an indispensable condition for a satisfactory examination. To accomplish this, fluoroscopy, spot roentgenography and a liberal quantity of patience is necessary. A standardized approach to all cases will produce mediocre results. Each case must be individualized to obtain the best results as the vagaries of esophageal motility and emptying cannot be predicted. As much time and effort should be allotted this examination as one is accustomed to expend on a diagnostic problem in some other part of the gastrointestinal tract. For the contrast agent we have found the conventional barium water mixture to be as satisfactory as anything presently available. We use a barium water paste of moderate consistency, usually 4 ounces of barium sulfate to 8 ounces of water. This mixture may have to be thickened or thinned as the individual situation requires. At periods we have employed mineral oil, glycerin, carboxymethylcellulose and dispersible pectin, but it has been our observation that no significant advantage accrued from the use of any of these agents. We should like to stress the importance of fluoroscopy and multiple spot roentgenography. Fluoroscopy will place the esophagus in optimum position for the examination and avoid roentgenography before the barium bolus clears the distal esophageal segment. Multiple spot roentgenograms will help eliminate errors of interpretation due to air bubbles, peristaltic contraction and inadequate coating of the mucosa.

The early diagnosis of esophageal varices requires the recognition of minor alterations in the contours and mucosal pattern of the lower esophageal segment. Varices may produce marginal scalloping similar to that seen in tertiary contractions and may on occasion provide some diagnostic difficulty. Tertiary contractions almost always occur in patients in the older age group, produce sharper marginal indentations, involve most of the thoracic esophagus and are usually easily recognized during fluoroscopy. Small varices may at first produce only subtle changes in the mucosal pattern. The sharp linear arrangement of the mucosal folds is replaced by a shallow waviness, and the spaces between the folds become widened. There may be loss of mucosal definition resulting in a mottled appearance. The latter is of particular significance in young patients. As the varices enlarge, the typical blotchy, polypoid radiolucent defects in the mucosa appear.

In certain cases gastric varices may be the dominant component of gastroesophageal varices, and without examination of the stomach the diagnosis may be missed. Varices may produce contour changes of the gastric cardia and fundus similar to those caused by neoplasm and should be

* Presented at the Fifty-seventh Meeting of the American Roentgen Ray Society, Los Angeles, California, September 25–28, 195

considered in the differential diagnosis.

Factors which may provide difficulty in obtaining a satisfactory examination are old age, a large phrenic ampulla and hiatus hernia. In older persons, atrophy of the mucosa may prevent adequate mucosal relief studies.

ANALYSIS OF RESULTS

Figure 1 is a summary graph of the patients in our series who had portacaval shunts. Here the data are depicted for 45 of the 57 patients who have undergone end to side portacaval shunts. The 12 patients discarded from this study did not have comparable postoperative esophagrams. In this graph the upper boarder of the block denotes preshunt portal pressure; the lower portion of the bar, portal pressure taken after the opening of the shunt. It will be noted that most of the initial pressures are well above the borderline level of 30 cm. of saline, although a few are in the twenties. All patients had had at least one significant hemorrhage, prior to operation, except No. 44, a young girl with intractable ascites and esophageal varices.

The portal pressure in most instances was reduced to between 15 to 20 cm. by the shunt and the final pressure was from 10 to 20 cm. of saline. The exceptions to this rule were patient No. 38 who had a thrombus in the portal vein which was not recognized on the preoperative splenoportal venogram and patient No. 30 who was one of the group with initially even portal pressures. Two patients in this series had explorations for other causes within a year of their portacaval shunts. Their portal pressure measured at that time was even lower than at the time of the closure of their shunt.

	Before Shunt	*Immediately After Shunt*	*Within 1 yr. After Shunt*
ED No. 7	46 cm. saline	26	17
AK No. 16	32 cm. saline	20	11

This observation correlates with the post-

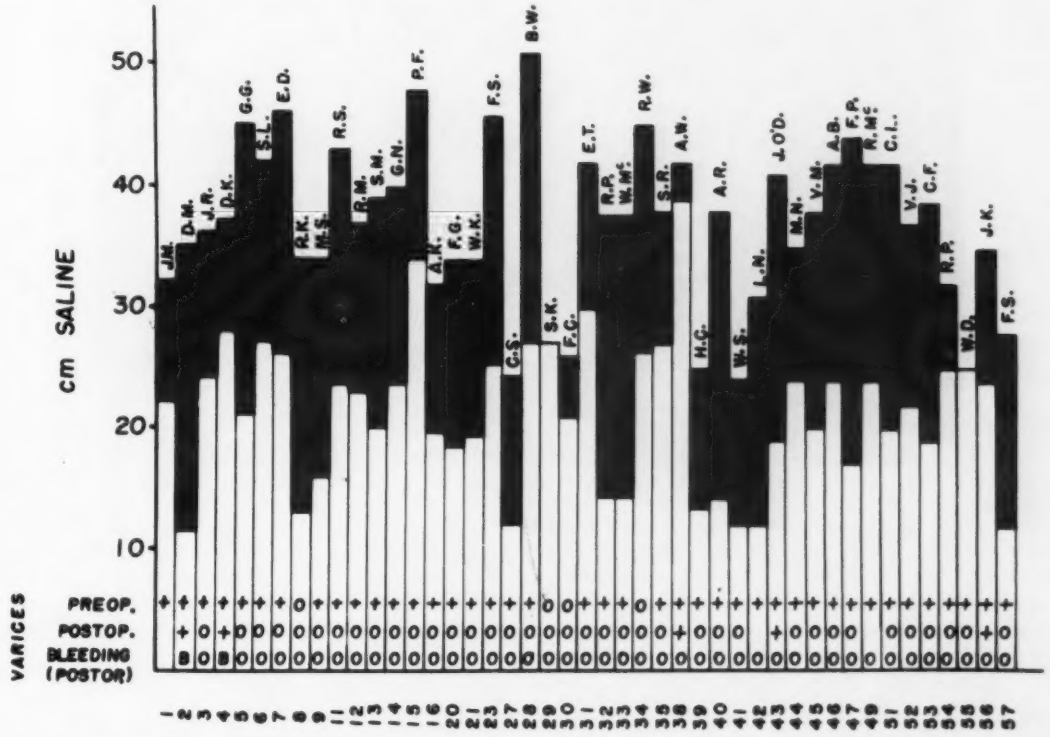

Fig. 1. Changes in esophagram and portal pressure following portal decompression (portacaval shunts).

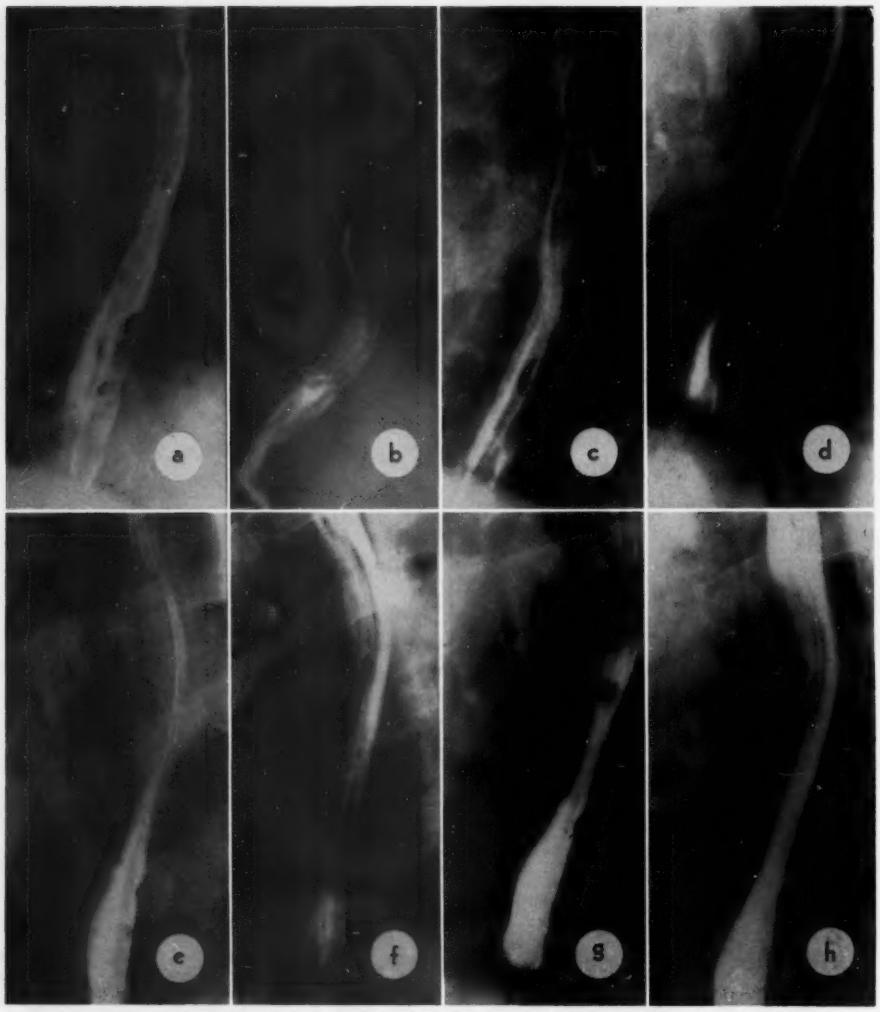

FIG. 2. Patient No. 11 in portacaval shunt series. Forty year old male with cirrhosis, esophageal varices and several hemorrhages. Satisfactory shunt, good drop in pressure, disappearance of varices and clinical well-being over a four year period. (*a*) Preoperative; (*b*) 1 mo. postoperative; (*c*) 6 mo. postoperative; (*d*) 1 yr. postoperative; (*e*) 2 yr. postoperative; (*f*) 3 yr. postoperative; (*g*) $3\frac{1}{2}$ yr. postoperative; (*h*) 4 yr. postoperative.

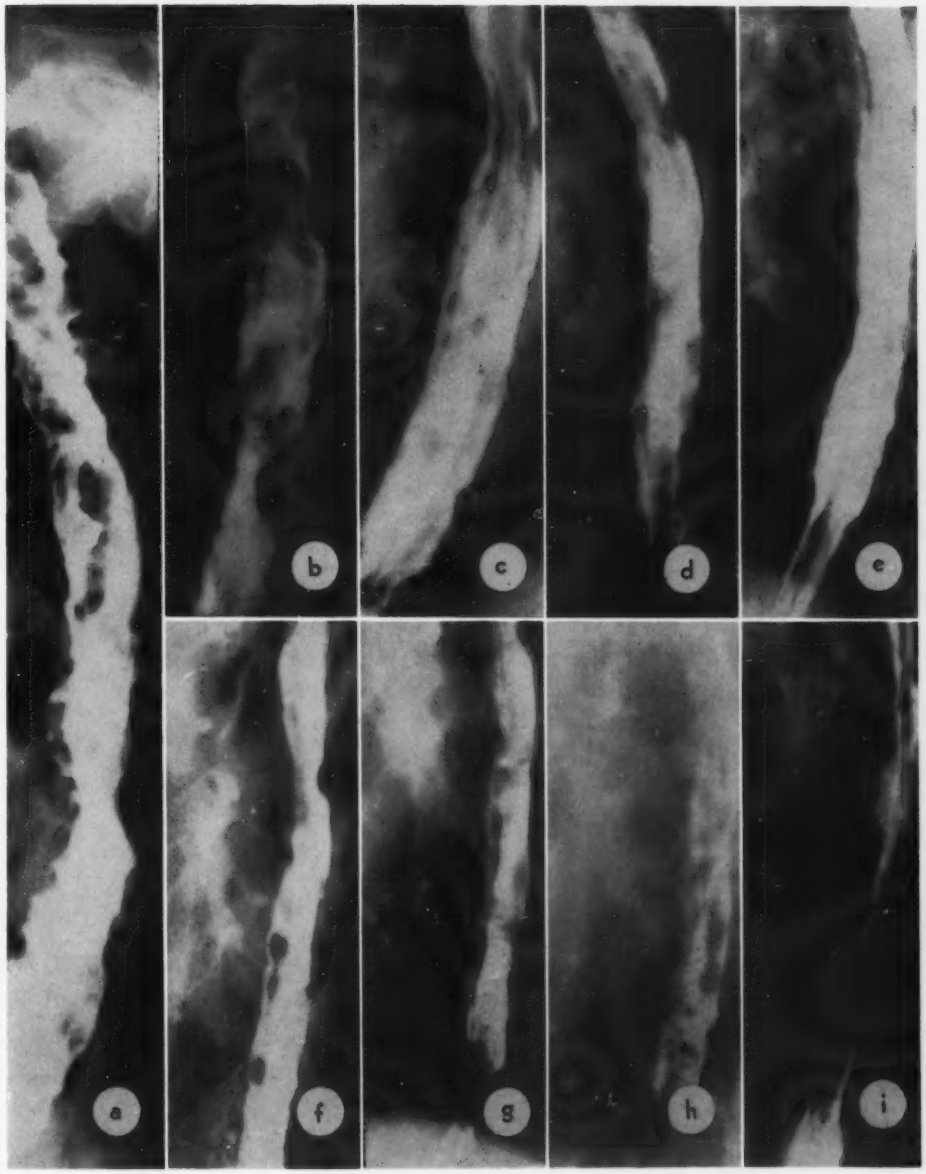

Fig. 3. Patient No. 43 in portacaval shunt series showing resolution of varices over a two and one-half year postoperative course. (*a*) Preoperative; (*b*) 11 da. postoperative; (*c*) 2 mo. postoperative; (*d*) 3 mo. postoperative; (*e*) 5 mo. postoperative; (*f*) 17 mo. postoperative; (*g*) 1½ yr. postoperative; (*h*) 23 mo. postoperative; (*i*) 2½ yr. postoperative.

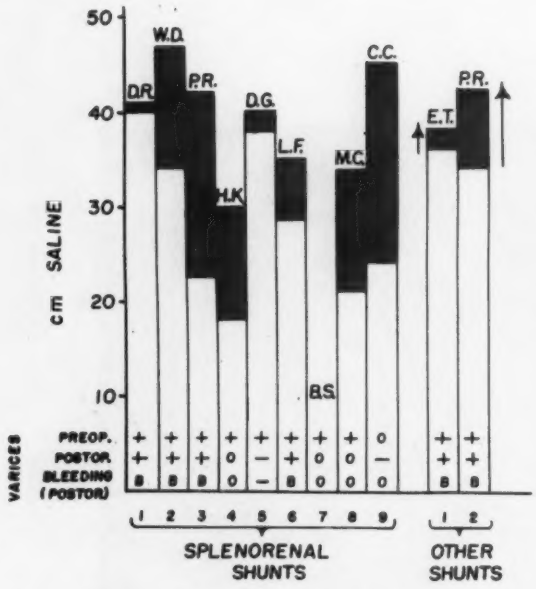

FIG. 4. Changes in esophagram and portal pressure following portal decompression.

operative roentgen esophagrams which showed a resolution of the esophageal varices over the course of several months. The majority of cases in which there has been an adequate decompression of the portal pressure revealed a disappearance of the esophageal varices within the first six month postoperative period (Fig. 2 and 3). Both cases strongly suggest, as has been stated by Child *et al.*[1] that in many instances a further gradual decline in portal pressure occurs during the immediate postoperative period. A labile portal pressure may also explain the phenomenon of varices being demonstrated at one examination and not on the next study.

The esophagrams prior to operation, with a few exceptions, showed varices. Patient No. 8 had a single esophagram which did not show the varices, but they were seen on esophagoscopy. Many of these examinations were made after hemorrhage during the emergency period. The postoperative esophagrams showed that 5 patients still had varices. Patients No. 2, 4 and 38 have bled. They were the only ones in the entire group who had a postoperative hemorrhage. Patient No. 2 was a fascinating man who had a flair for the unusual. He had a tapeworm, took carbon tetrachloride which did not budge the worm but gave him severe jaundice. He drank heavily, bled, had a shunt and left New York. Two years later he returned with bursitis of the right shoulder, pleurisy and massive edema of both legs. He died of a primary carcinoma of the liver which grew through the diaphragm and completely obstructed the superior vena cava. The shunt was patent at postmortem examination. Patient No. 4 also died of carcinoma, probably primary in the lung. Her esophagram had been negative and turned positive prior to her death. Patient No. 38 had a portal vein thrombosis and following the shunt her final portal pressure was 39 cm. of saline. Postoperatively her varices persisted and two years later she again had a large hematemesis. A second attempt was made to reduce her portal pressure by a splenorenal shunt. This, too, failed as did a subsequent esophagogastrectomy. Patient No. 56 has as yet an insufficient postoperative follow up. That leaves patient No. 43 who has the only positive postoperative esophagram unexplained. His shunt appeared technically satisfactory. Portal pressure dropped from 41 to 19 cm. Clinically he seems well. It has been one year since his shunt and he has had 7 esophagrams all showing large varices. This is the only patient in the whole series whose esophagram does not correlate with the observed portal pressure changes. Time will tell how his clinical course will run.

Figure 4 shows in graph form the esophagram and portal pressure change in 9 splenorenal and 2 superior mesenteric to caval shunts. It will be noticed that 6 of these patients have bled since their shunts. Numbers 1, 2 and 6 splenorenal and No. 1 and 2 other shunts did not have satisfactory falls in pressure at the time of the operation and so their hemorrhage was not unexpected. Varices remained present on their esophagrams. All bled again after operation. Number 3 had a good pressure drop but subsequently thrombosed her shunt

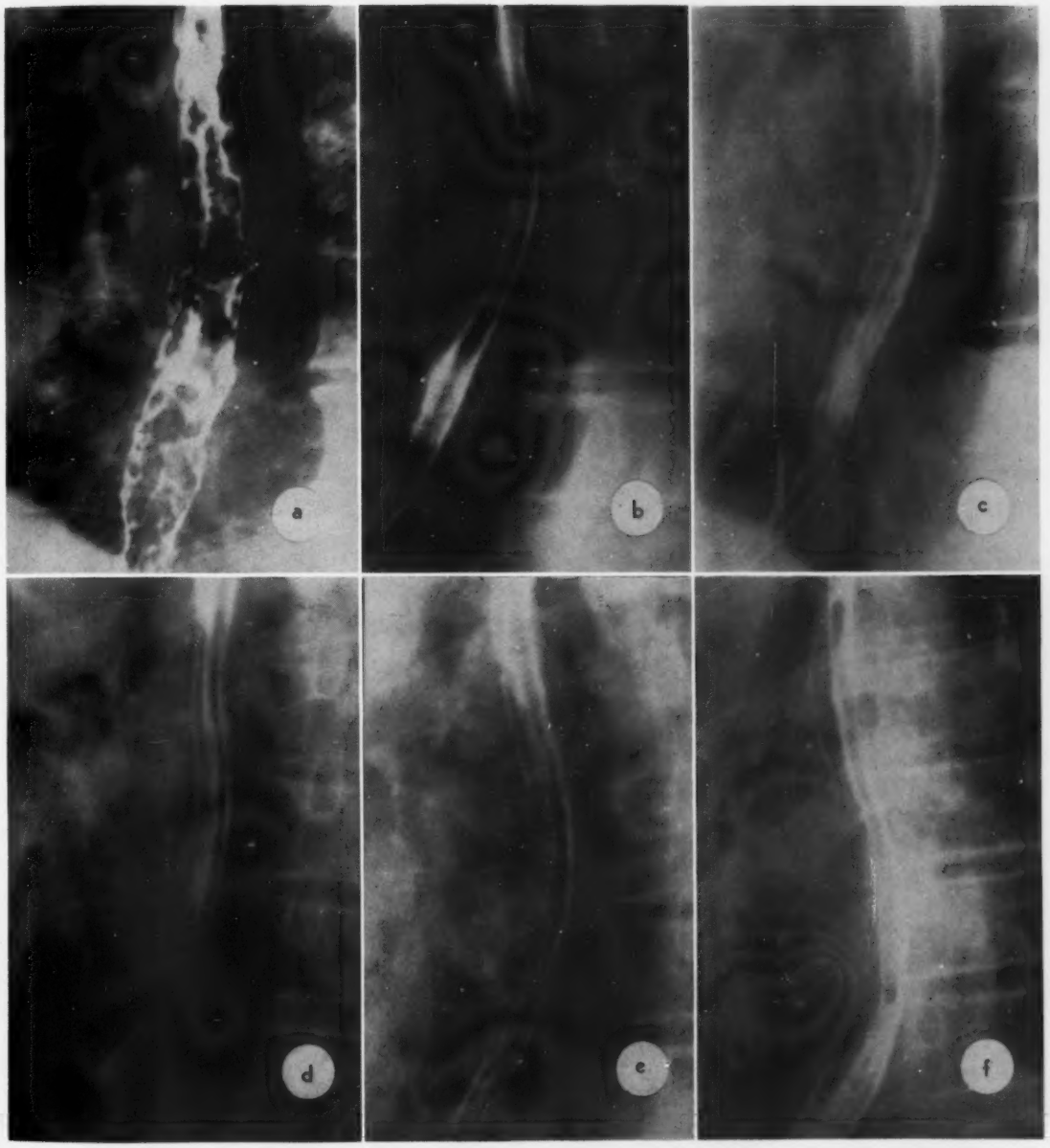

Fig. 5. Patient No. 4 in splenorenal shunt series. Fifty-four year old cirrhotic male with bleeding esophageal varices. Satisfactory shunt, good fall in pressure, disappearance of varices and clinical well-being over a four year period. (*a*) Preoperative; (*b*) 1 mo. postoperative; (*c*) 1 yr. postoperative; (*d*) 2 yr. postoperative; (*e*) 3 yr. postoperative; (*f*) 4 yr. postoperative.

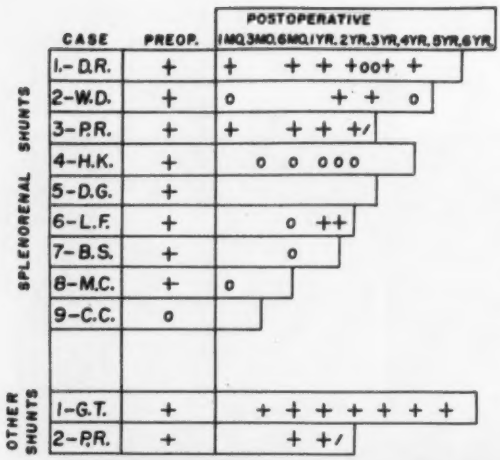

FIG. 6. Graph shows in another form the consistency of the esophagram as a serial study. This is the same group of cases diagnosed with a time sequence, starting with the preoperative esophagram and following the course over a six year period.

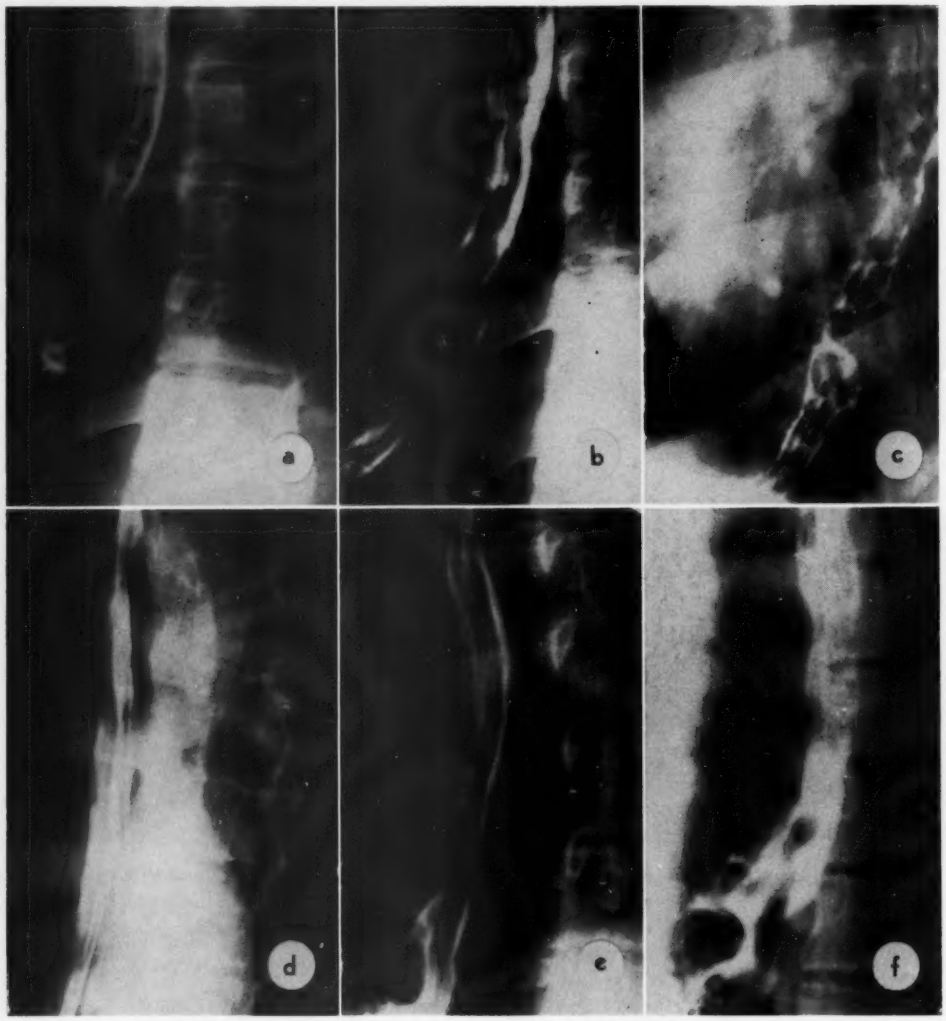

FIG. 7. Patient No. 1 in splenorenal shunt series. Fifteen year old female with portal hypertension and bleeding varices secondary to extrahepatic obstruction. Unsatisfactory shunt—persistent varices and recurrent hemorrhage. Esophagogastrectomy with again recurrence of varices. Six year course. (*a*) Before shunt; (*b*) 6 mo. after shunt; (*c*) 15 mo. after shunt; (*d*) esophagogastrectomy; (*e*) 1 mo. after esophagogastrectomy; (*f*) 1½ yr. after esophagogastrectomy.

and she is shown as No. 2 in the other shunt series, after another attempt at portal decompression, which also failed. The initial pressure of 36 cm. rose to 42 during the procedure. She bled repeatedly and died. Patient No. 4 is the only adult case of Laennec's cirrhosis in the splenorenal series. He had a good drop in pressure and has remained well for four years with consistently negative esophagrams (Fig. 5). Numbers 8 and 9 are too early in their course for prognostication but appear well. Here again, as in the portacaval series, the correlation of bleeding with persistent positive esophagrams is striking.

Figure 6 shows in another form the consistency of the esophagram as a serial study. This is the same group of cases diagnosed with a time sequence starting with the preoperative esophagrams and following the course over a six year period. Patient No. 1, a fifteen year old girl, had a splenorenal shunt for bleeding esophageal varices. She had an inadequate fall in pressure after the shunt and because of recurrent hemorrhage, two years later had an esophagogastrectomy. This was followed by a short interval of negative esophagrams. However, at five months and one and a half years after the esophagogastrectomy, varices were again demonstrated in her esophagrams (Fig. 7). Patient No. 6 is a young technician with a similar story. Patient No. 4, who had a good fall in pressure following shunt, has been well and without roentgen evidence of varices over a four year period. The contrast between patient No. 4 and patient No. 1 is striking. The former over a four year period of observation has been well; the latter during a six year period has had frequent hemorrhages.

SUMMARY

Our experience has demonstrated roentgen examination of the esophagus for varices to be an extremely useful diagnostic procedure in following the patient with portal hypertension. In the shunt series it correlates extremely well with the results expected from portal pressure taken in the operating room. It also correlates closely with the observed clinical course of the patient and alerts the clinician to the danger of impending hemorrhage.

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REFERENCE

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THE BALLOON TUBE AS AN AID IN ROENTGENOLOGIC EXAMINATIONS OF THE ESOPHAGOGASTRIC REGION*

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ACCURATE roentgenologic examination of the esophagogastric region has been hampered by a number of factors. First, the region can be palpated only with difficulty. Secondly, as shown by Palmer,[3] the esophagogastric mucosal junction is difficult to identify without using special methods such as the application of metal clips to the mucosa. Thirdly, it is exceedingly difficult to identify accurately the position of the esophageal hiatus. This may be demonstrated by roentgenologic examination performed upon patients who have had metal clips inserted into the hiatus at the time of surgical exploration (Fig. 1). This method has also been employed by Monges and associates[2] and Botha.[1] It is the purpose of this communication to describe the use of a balloon tube as an aid in the roentgenologic examination of the esophagogastric region.

MATERIAL AND METHOD

The balloon tube,† which has been described previously,[4] consists of a triple lumen tube, with three balloons of graduated size attached to one end. Ordinarily the balloons can be inflated to form fairly rigid spheres measuring approximately 1, 2, and 3 inches in diameter. The tube is passed via the nose into the stomach prior to roentgenologic examination. The smallest balloon is then inflated within the stomach, after which it is drawn through the esophageal hiatus into the lower esophagus. Barium mixture is swallowed by the patient at intervals to outline the esophagus and stomach. It has been demonstrated[4] that the balloon tube provides information regarding the size of the esophageal hiatus and the position of the inferior esophageal constrictor. In this study one of the larger balloons was replaced by one of thin latex rubber. The latter provided a sphere which remained pliable when inflated with several hundred cubic centimeters of air. Thus it was possible to employ the rigid balloons to measure the size of the hiatus and to study the lower esophagus, and the soft balloon to study the infradiaphragmatic portion of the stomach.

FIG. 1. Left lateral roentgenogram showing silver clips which were inserted into the anterior and posterior edges of the esophageal hiatus after transthoracic repair of a hiatal hernia. Note that the hiatus appears to lie within the thorax well above the diaphragm.

† Manufactured by the Davol Rubber Company, Providence, Rhode Island.

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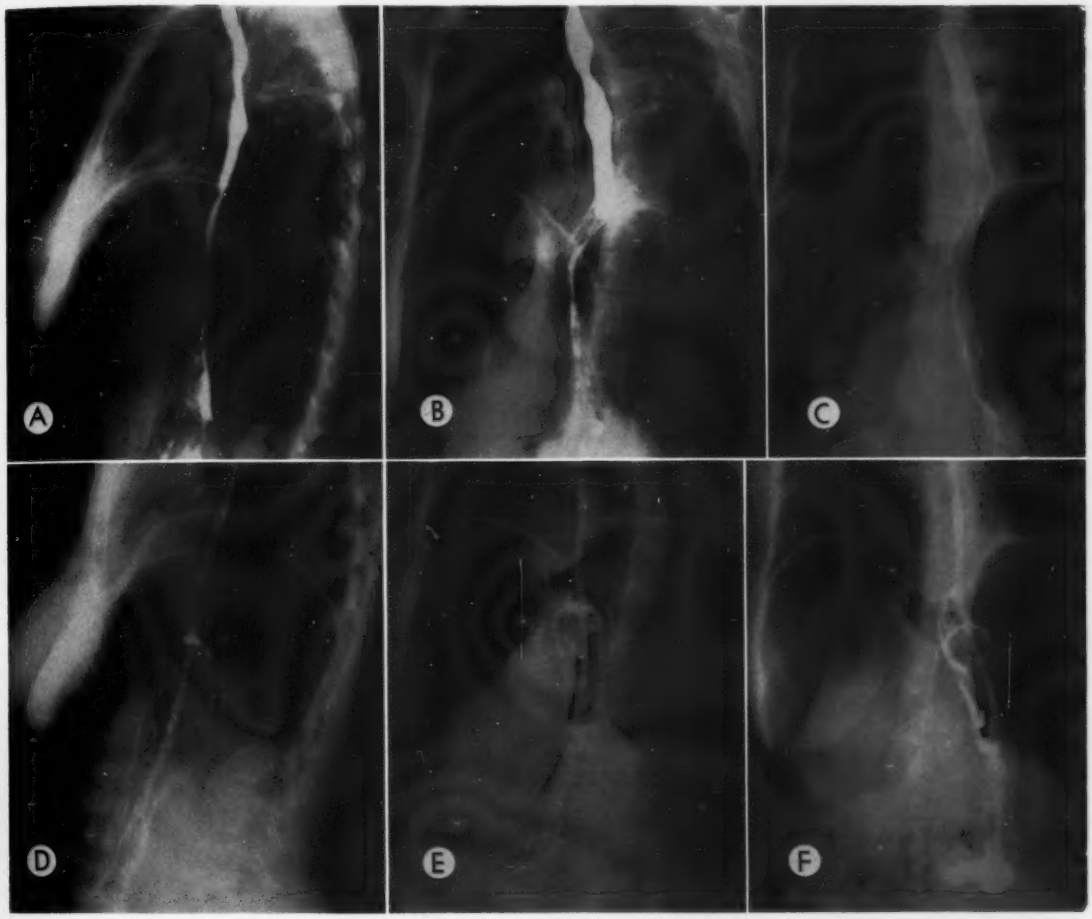

Fig. 2. Roentgenograms of a patient with pneumoperitoneum and with no evidence of gastrointestinal pathology. (*A*, *B* and *C*) After swallow of a thick barium mixture. (*D*, *E* and *F*) Similar roentgenograms with the 1 inch balloon against the abdominal aspect of the esophageal hiatus. Note that the hiatus lies well below the elevated domes of the diaphragm.

Several patients who complained of gastrointestinal symptoms were receiving pneumoperitoneum for pulmonary conditions. They afforded excellent opportunities to study the anatomy of the esophagogastric region, since the diaphragmatic surfaces could be outlined with a greater degree of accuracy than usual.

RESULTS

Figure 2, *A*, *B* and *C* reveals that it is difficult to determine the position of the esophageal hiatus even in the presence of pneumoperitoneum. It is usual to assume that the hiatus lies where the lower esophagus bends sharply forward or where a constriction can be seen near the diaphragm. Figure 2, *D*, *E* and *F* of the same patient with the balloon held by traction against the inferior portion of the hiatus reveals that the hiatus is actually lower than suspected. On the other hand, Figure 1 reveals that the hiatus, marked by metal clips, seems to lie well above its suspected position.

Figure 3*A* reveals a balloon lying in the supradiaphragmatic portion of a herniated stomach. The balloon is being held against the inferior esophageal constrictor by traction upon the tube. Figure 3*B* shows the larger balloon lying against the infradiaphragmatic aspect of the esophageal hiatus. Thus it can be seen that the balloon tube provides a method of localizing both

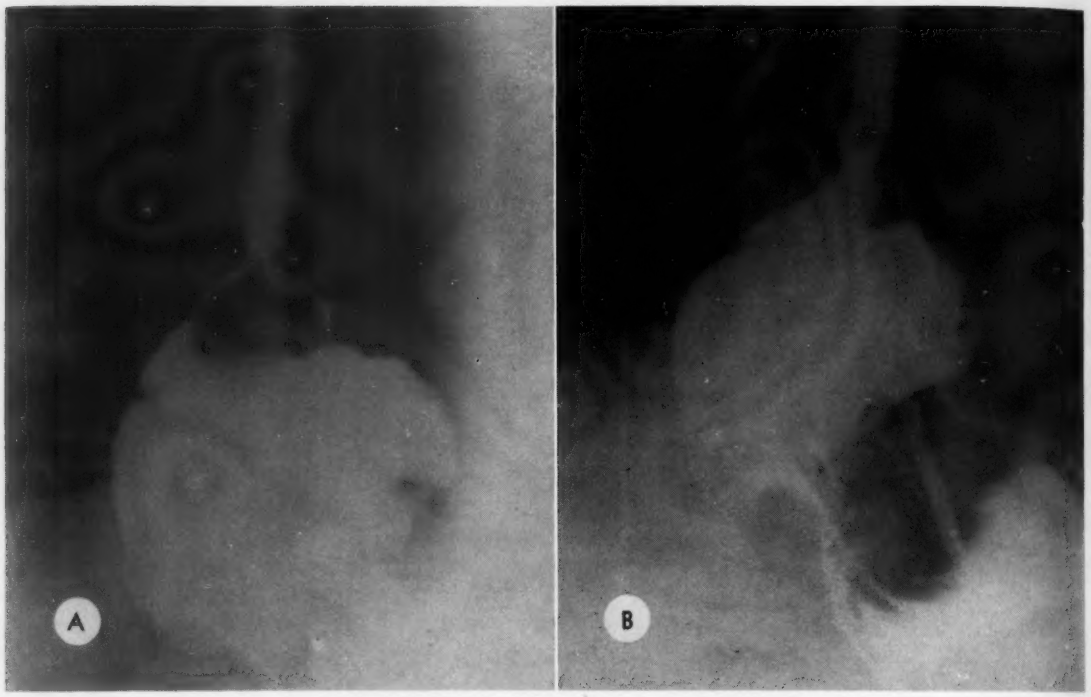

FIG. 3. Right anterior oblique roentgenograms of a patient with a large hiatal hernia. (*A*) The 1 inch balloon lies in the intrathoracic portion of the stomach against the inferior esophageal constrictor. (*B*) The larger balloon lies against the esophageal hiatus in the abdominal portion of the stomach.

FIG. 4. Roentgenogram showing the use of the large intragastric balloon to demonstrate the rugal pattern.

the esophageal hiatus and the inferior esophageal constrictor. The latter usually lies a short distance above the esophagogastric mucosal junction.

Figure 4 portrays the use of the large soft balloon to demonstrate the gastric rugal pattern in a region which is not usually accessible to manipulation, and which is considered by many to be relatively difficult to examine by ordinary roentgenologic methods.

CONCLUSION

Experience has indicated that the balloon tube can be an aid in the roentgenologic examination of the esophagogastric region. It may be used to localize the esophageal hiatus and the inferior esophageal constrictor which is usually situated near the esophagogastric mucosal junction. It may be used as an aid in examinations of the fundus of the stomach, which by ordinary methods may be difficult. Also, the tube may be used to provide a rough measurement of the size of the esophageal

hiatus. However, as previously noted,[4] the size of the esophageal hiatus is not necessarily an indication of the presence or absence of a hiatal hernia. For this reason, the balloon tube may not be helpful in the detection of small hiatal hernias.

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FACE-ON DEMONSTRATION OF ULCERS IN THE UPPER STOMACH IN A DEPENDENT POSITION*

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ROENTGEN examination of the upper part of the stomach is generally thought to be difficult because it is beyond reach of palpation. For many years we have found it possible to examine this part of the stomach with comparative ease by systematic use of gravity.

The underlying principle is old. Berg[1] applied it, so did Rendich[3] and others (Golden,[2] Schinz-Baensch-Friedl-Uehlinger,[4] and Templeton[5]). Nevertheless, this simple and very rewarding procedure is apparently not as widely employed as it might be. This is documented by the scarcity of relevant illustrations in the literature concerning this area.

The systematic use of this procedure has long been an important part in our routine examination of the upper part of the stomach. On account of it, we feel that it is no more difficult to examine this part of the stomach than it is to study the antrum.

This paper will confine itself to a study of the value of the method in the diagnosis of ulcer in the upper part of the stomach.

PRINCIPLE AND METHOD OF EXAMINATION

The principle of the procedure consists in placing the patient so that the suspected ulcer bearing region of the stomach is in a dependent position, filling this area with barium, and then rotating the patient so that the surplus of barium is removed. By this method the ulcer, which is filled with barium, is generally visualized on the face-on roentgenogram.

Since most ulcers occur at or near the lesser curvature, an attempt is made to place the stomach so that the lesser curvature of the fundus and the body of the stomach form the dependent region examined. In most instances this can be done quite simply by rotating the supinely placed patient towards his right side (Fig. 1). When the patient lies on his back, the barium collects in the fundus of the stomach. By rotation towards the right side, the barium runs out of the fundus along a trough which is formed by the lesser curvature and the adjacent portions of the anterior and posterior walls. The degree of rotation determines how much barium leaves the fundus and how far down the coating of the lesser curvature occurs (Fig. 2 and 3). If there is too much barium in the region of the lesser curvature, part or all of it may be returned to the fundus by turning the patient on his back or towards his left side.

With this procedure, not only the lesser curvature but also the adjacent parts of the anterior and posterior walls of the stomach may be studied in a face-on projection. At the same time, large portions of the anterior and posterior walls are seen in profile.

These studies become considerably more versatile if the rotation maneuvers are not confined to the horizontal position, but are also done with the table tilted only part way from vertical to horizontal. There are several advantages to examining the patient with the table partly tilted. As is shown in Figure 4, a greater portion of the stomach lies horizontally in one plane when the table is tilted than when the table is horizontal. If the stomach is in one horizontal plane, one can shift barium about in the stomach with minimal degrees of rotation of the patient. At times it is very helpful to do this, since shifting a thin layer of barium permits a "palpation-like" examination of the lesser curvature by rolling the patient back and forth while he lies on

* From the Department of Radiology, Mount Auburn Hospital, Cambridge, Massachusetts. Presented at the Fifty-eighth Annual Meeting of the American Roentgen Ray Society, Washington, D. C., October 1–4, 1957.

his right side. Not only ulcerations but also areas of increased rigidity may be discovered in this manner.

The combination of proper table tilt and proper degree of rotation of the patient permits a more thorough examination. The amount of barium coating as well as the projection of various parts of the upper stomach can be varied at will, since the barium will flow out of the fundus with less rotation of the patient when the table is tilted.

Finally, in some persons the stomach tends to fall backwards upon the fundus when the table is in horizontal position. This results in foreshortening of the projection of the body of the stomach (Fig. 5). This tendency may be obviated by examination with the table partly tilted. The optimal degree of tilting varies with each patient, depending upon the shape and position of the stomach. The examiner soon acquires a feeling of the proper tilting in a given patient. Usually an angle about 60 degrees from vertical is satisfactory.

Fig. 1. Rotation of the supinely placed patient to the right causes the barium to run along the lesser curvature.

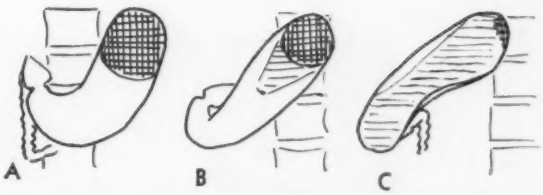

Fig. 2. A schematic drawing showing the travel of barium when the patient is in supine position and turned to the right side. (*A*) shows the barium in the fundus. *B* and *C* show the increasing coating of the lesser curvature area with increased rotation of the patient.

In practice, the examination is carried out without appreciable additional irradiation of the patient if study in the horizontal position forms a part of the examiner's routine. After roentgenoscopy in the upright position, the table is tilted back about 60 degrees. If barium has not run back into the fundus, it will if the patient is turned momentarily towards his left side after which he is turned towards his right side. The lesser curvature is observed face-on while the barium ebbs and flows like a wave across the beach, leaving holes filled with water. Gentle rocking of the patient (Fig. 1) will bring the proper amount of coating over the area desired and leave the ulcer filled with barium. Spot roentgenograms are taken as indicated.

The table is then brought to the horizontal plane and the maneuver repeated. This additional procedure is not necessary when a good view has been obtained with the table in a partly tilted position. For practical reasons, we usually perform the rotation maneuver after the patient has been studied in the upright position. If the main interest is in the upper part of the stomach, the examination is best begun in the horizontal plane, then the table tilted and finally the patient examined in the erect position.

While this very simple procedure suffices in the great majority of cases, the shape of the stomach or the unusual location of the lesion may at times require unusual maneuvers to obtain proper coating with barium.

FIG. 3. The upper portion of the stomach with various degrees of rotation. The patient is in supine position on a horizontal table. The roentgenograms were taken in rapid succession with the same amount of barium. (*A*) Patient tilted to the left. (*B*) Straight anteroposterior projection. (*C*) Patient tilted moderately to the right. (*D*) Patient tilted more markedly to the right. In (*D*) the lesser curvature forms the dependent portion of the stomach and can be followed up into the fundus.

Fig. 4. Relationship of the stomach to the horizontal plane with the patient in upright, tilted and horizontal position.

Rotation in the Trendelenburg position or other procedures may be helpful. Their proper use depends upon the ingenuity and imagination of the examiner. The principle remains the same: the ulcer must be filled with barium while it is in a dependent position.

The presence of air in the stomach at times aids in locating a lesion (double contrast demonstration). At other times air prevents proper coating of the wall and is a hindrance rather than a help.

In practice this method of examination has proved valuable in various ways.

1. It is helpful in the discovery of gastric ulcers, particularly in the upper part of the stomach. At times ulcers demonstrated in the face-on dependent position completely escape detection in profile. Demonstration in profile is sometimes very difficult even after the ulcer had been seen face-on (Fig. 6–8).

2. Follow-up examinations of gastric ulcers are considerably facilitated and are more accurate. The size of the ulcer is usually more reliably demonstrated. Scarring is more clearly visible and the residual scar may be seen when the profile view of the ulcer has acquired completely normal appearance (Fig. 6–11).

3. Demonstration of the shape of the ulcer and of the rigidity of the area surrounding the crater is possible even in regions where palpation cannot be done. For this reason, face-on demonstration in the dependent position is helpful in differentiation between cancer and ulcer.

4. The method aids in the examination of

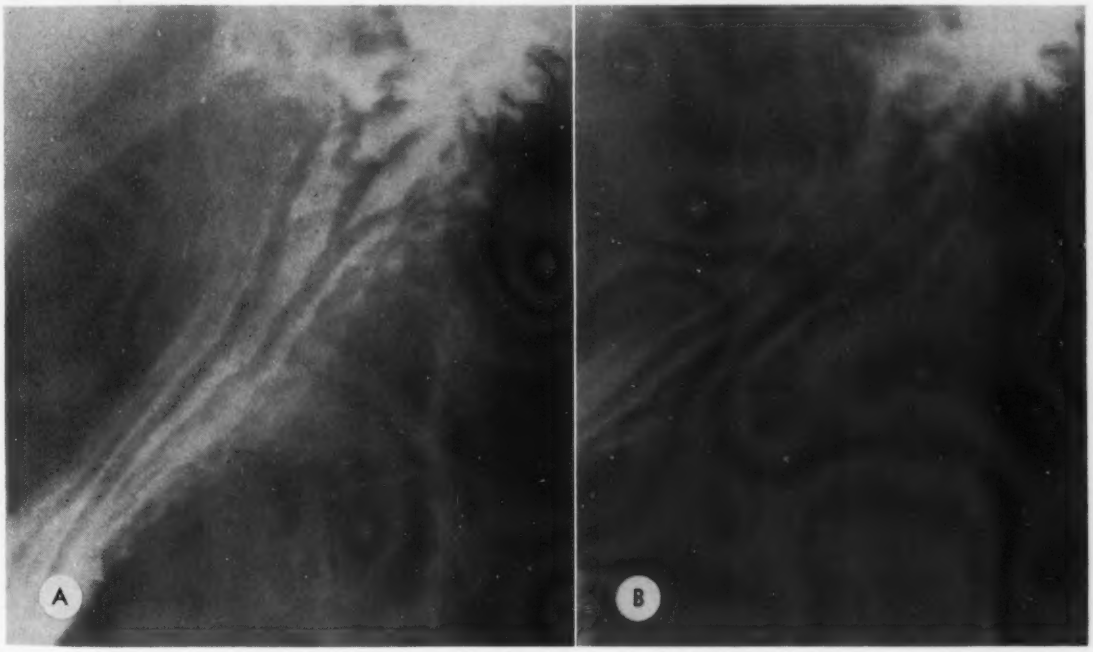

Fig. 5. Influence of table tilting. (*A*) No foreshortening of the upper part of the stomach with the table tilted approximately 60 degrees as compared with the slight foreshortening which takes place when the patient is in horizontal position. (*B*) The two roentgenograms were taken immediately following each other with the same amount of barium. The patient was left exactly in the same degree of rotation to the right for both exposures.

FIG. 6. W.N., physician forty years old. Two episodes of bleeding. Repeated previous examinations were negative. At this examination, no ulcer was seen at the beginning of the examination in the upright position. When the patient was rotated to the right side while lying on the semi-reclined table, a large crater was clearly seen high on the lesser curvature (*A*). Even then, after the presence and the position of the ulcer were known, the demonstration of the ulcer in the upright position remained difficult (*B*). No ulcer was seen in the prone position (*C*). See also Figure 7 and 8.

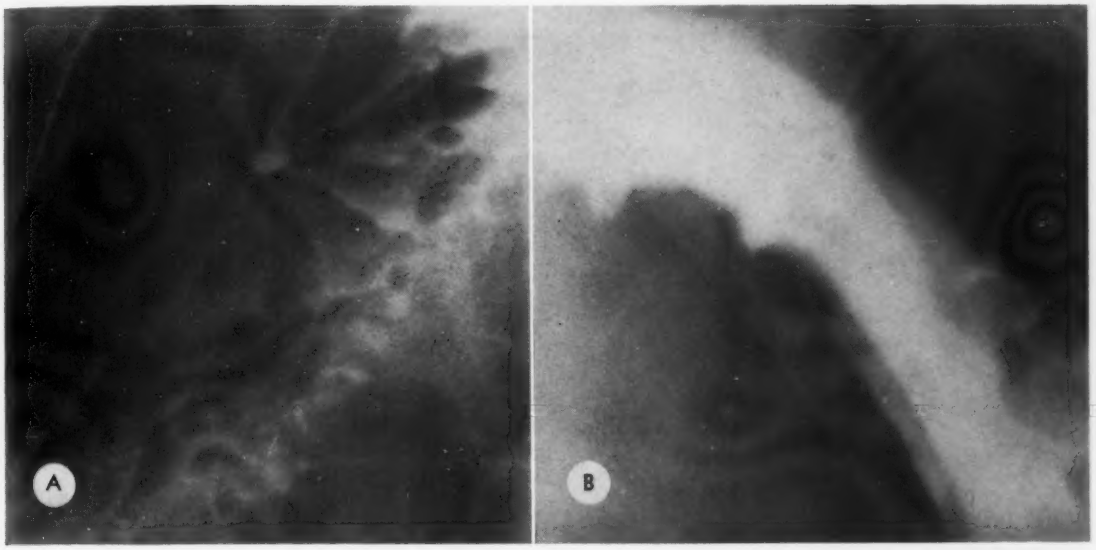

FIG. 7. Same patient three weeks later. The ulcer, which has decreased in size, and the increased convergence of the mucosal folds are clearly seen in the face-on view in the dependent position (*A*), whereas the ulcer has become quite insignificant in the profile roentgenogram (*B*).

patients with massive hemorrhage from the upper gastrointestinal tract. In these cases, profile demonstration of an ulcer is made difficult by examination in the horizontal position only, due to foreshortening of the lesser curvature. If the recumbent patient is rotated towards his right side, not infrequently the first swallow of barium reveals an ulcer in the upper portion of the stomach.

5. Upon occasion, folds protrude from the lesser curvature near the cardia and produce an ulcer-like appearance. Palpation of this area is impossible. Differentiation between ulcer and a normal mucosal fold is usually easy if one brings the area in question into a dependent position. Any ulcer visible in profile should be easily detected in the face-on dependent position.

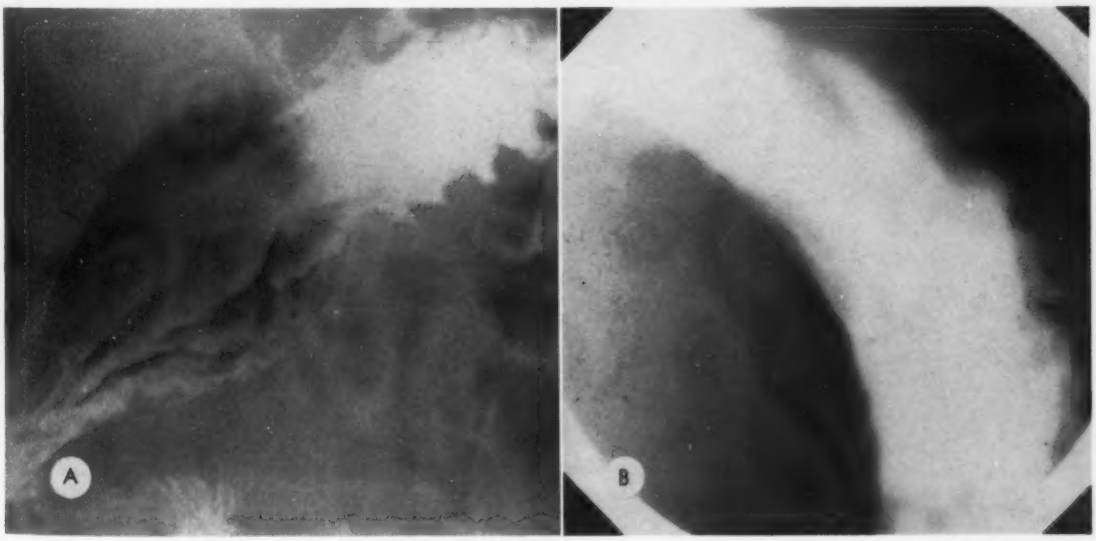

FIG. 8. Same patient, four weeks after first examination (Fig. 7). The ulcer is no longer visible. The face-on, dependent view, however, still indicates the scar (*A*).

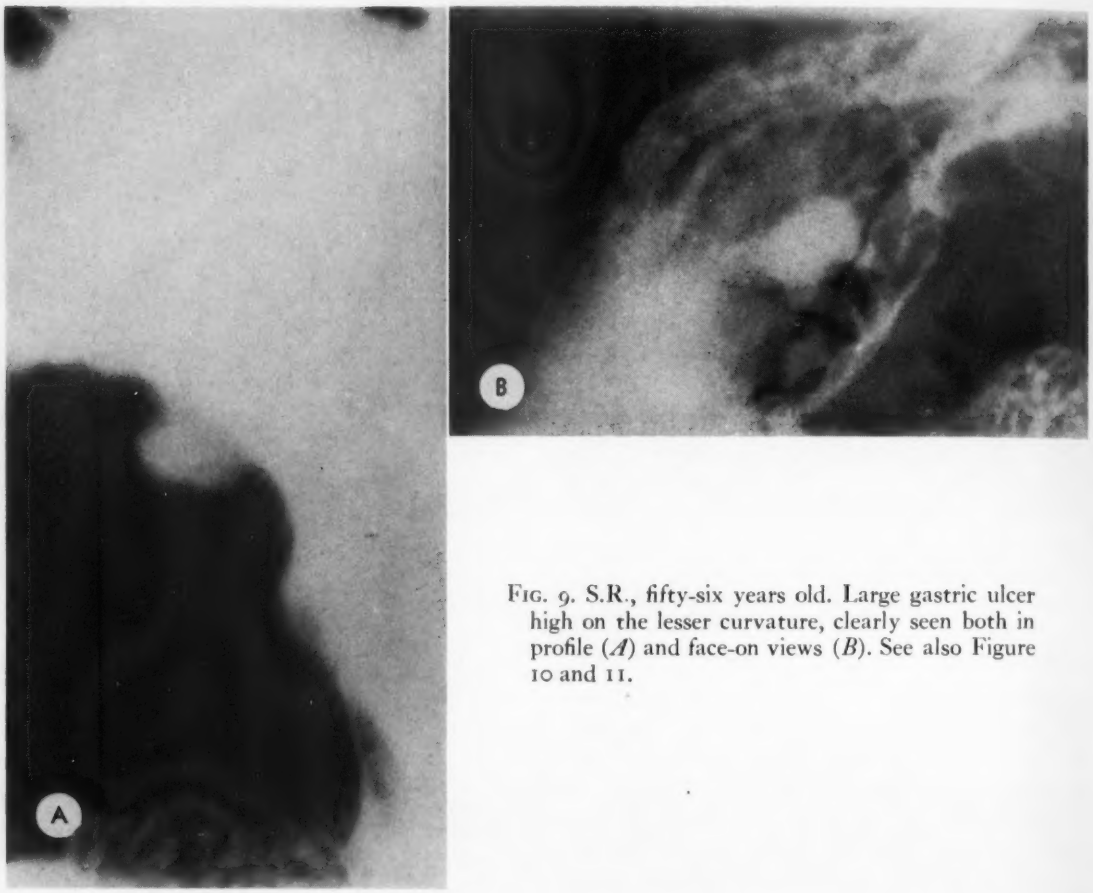

FIG. 9. S.R., fifty-six years old. Large gastric ulcer high on the lesser curvature, clearly seen both in profile (*A*) and face-on views (*B*). See also Figure 10 and 11.

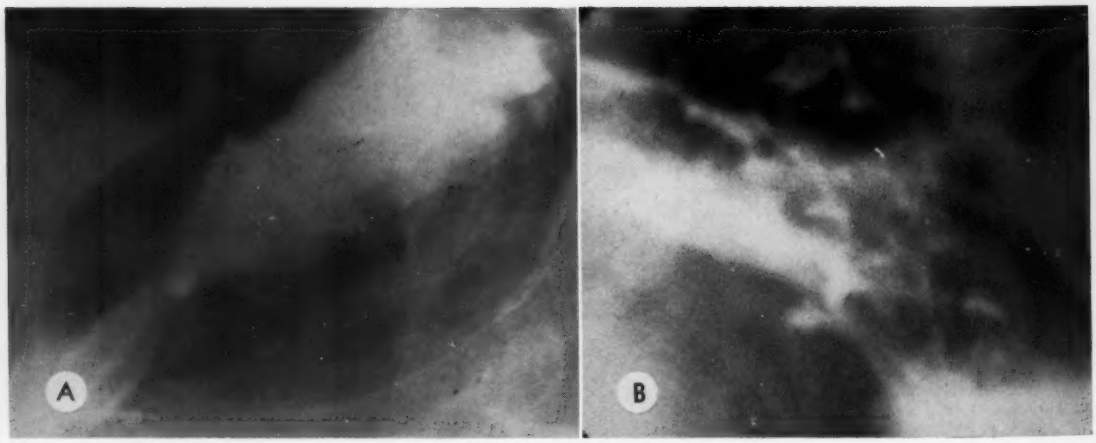

FIG. 10. Same patient three weeks later. The ulcer has decreased in size. Its demonstration in the face-on dependent position (*A*) is clearer than in the profile roentgenogram (*B*).

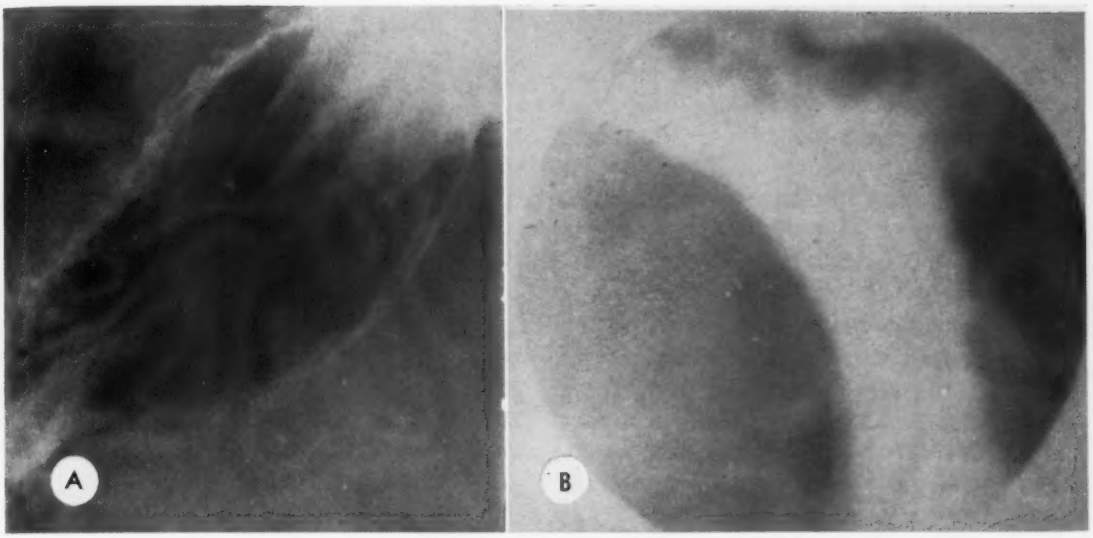

Fig. 11. Same patient four weeks after previous examination (Fig. 10). The scar is visible in the face-on dependent position (*A*). The profile roentgenogram appears normal (*B*).

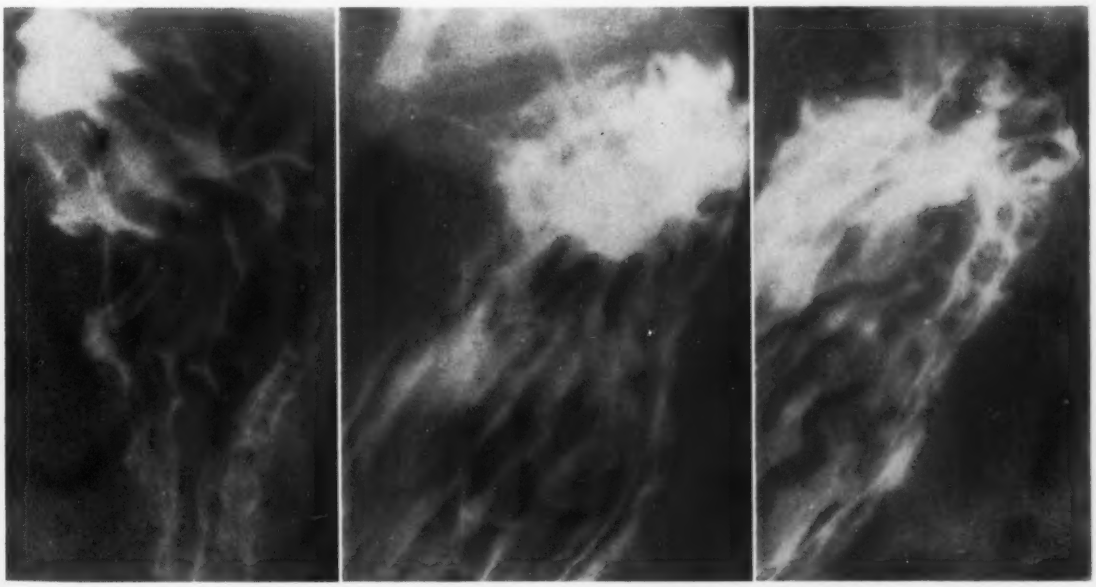

Fig. 12. Importance of face-on, dependent roentgenograms for the differential diagnosis of ulcer and gastric folds. An ulcer had been diagnosed on two recent occasions because of the appearance of the lesser curvature below the cardia. Face-on roentgenograms showed no evidence of an ulcer and, therefore, ruled out the presence of an ulcer of the size of the barium filled pocket seen in the profile roentgenogram. Barium apparently was present between thick folds. Follow-up examination eight months later showed an identical appearance of the upper end of the stomach. The patient was asymptomatic.

If it is not, an ulcer can be excluded with a great degree of certainty (Fig. 12).

6. Profile demonstration of the lesser curvature in patients with a high, horizontal type of stomach may be very difficult or impossible. In these patients, examination of the lesser curvature in a dependent position may be the only possible way to demonstrate this part of the stomach.

SUMMARY

Face-on demonstration of gastric ulcers in a dependent position is a valuable and frequently the most important part of the examination, especially of the upper part of the stomach.

The principle and the method of this examination are described.

This approach has proved helpful in the detection of gastric ulcers, in the study of their healing, in the differentiation between benign and malignant ulcerations, in the examination of patients with massive bleeding, in the differentiation between ulcers and normal mucosal folds near the cardia, and in the examination of patients with a high, horizontal stomach.

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We are grateful to Dr. Jack Dreyfuss for furnishing us with the sketch of Figure 1.

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SUPERFICIAL SPREADING GASTRIC CARCINOMA: IS IT DETECTABLE ROENTGENOLOGICALLY?*

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THE roentgen detection of gastric carcinoma depends almost as much on the morphology that the disease takes as upon its actual size. Polypoid and ulcerative carcinomas of very small dimensions are quite regularly uncovered while an infiltrating type of neoplasm of similar order may be overlooked. If, in addition, the infiltrative carcinoma is not of the deep variety but grows in the mucosa and submucosa, tending to spare the muscle layers, the roentgenologist is hard pressed indeed to identify any disturbance. In this regard, therefore, superficial infiltrating carcinoma is a most challenging form of malignant neoplasm.

Gastric carcinomas are classifiable roentgenologically on the basis of their most prominent morphologic feature. As is well known, most neoplasms present a mixture of the three possible morphologic characteristics although occasionally a more or less pure polypoid, ulcerating or infiltrating form of gastric carcinoma is encountered. The roentgen classification we employ is as follows: (1) polypoid; (2) ulcerative; (3) infiltrative: (a) deep and (b) superficial.

This simple roentgen classification and its application in our department differs somewhat from the classification presented by Golden and Stout,[1] particularly as regards superficial spreading carcinoma. Stout divides this kind of gastric carcinoma into two types, the ulcerative, comprising 11.2 per cent of the total carcinoma material and the nonulcerative, making up only 2.8 per cent. In the roentgen classification used here, the ulcerative form of superficial spreading carcinoma would be listed under the ulcerative carcinoma category. Therefore, it is Stout's nonulcerative form of superficial spreading carcinoma with which we choose to deal.

While localized polypoid and even ulcerating carcinomas may be relatively superficially located in the stomach wall, they are not to be considered in this study because the mass or ulcer, as the case may be, would constitute their obvious roentgen feature, and generally speaking, the roentgen detection of superficial carcinomas of these types is easy and reliable.

Stout[2,3,5] states that the characteristic feature of superficial spreading gastric carcinoma is its tendency to involve the mucosa and submucosa. The distribution is often in a continuous sheet, but it may be in the form of a number of separate plaques. He differentiates the disease from carcinoma *in situ* because in the latter the mucosa alone is the location of the lesion. Just how frequently it is possible to detect carcinoma *in situ* roentgenologically we cannot tell at this time. Rigler[4] cites two instances of gastric carcinoma *in situ* in which the roentgen study disclosed some abnormality. It is evident, however, that many lesions of this type escape roentgen detection. Stout continues by saying, in regard to superficial spreading carcinoma, "The malignant growth replaces the mucous membrane, usually obliterates the mucosal folds and smooths out the surface. In the surrounding area the mucosal folds radiate toward the cancer and reach the edge of the involved area. In some places the tumor cells extend into the folds for a short distance and widen them. The malignant disease usually penetrates through the muscularis mucosae into the submucosa."

From a review of the charts of proved stomach cancers in this hospital, we were able to obtain a few examples of superficial spreading carcinoma with adequate roentgenologic coverage. The gross pathologic descriptions of much of the stomach cancer

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FIG. 1. Case 1. Negative appearing stomach, but at operation a carcinoma of the lesser curvature of the lower segment of the stomach was found. This was largely confined to the mucosa.

material and the correlation between the gross and microscopic diagnosis were such that it was not easy to obtain a clear picture of the precise morphology of the entire cancer in many cases.

It became apparent that a close correspondence between the roentgen and pathologic concepts of this morphologic form of stomach carcinoma did not always exist. The difference seemed to center largely upon the degree of stomach wall involvement. Some carcinomas, called superficial spreading pathologically, showed roentgen evidence of deep wall invasion and actually the roentgen diagnosis was easy. Perhaps the presence of an inflammatory process or even spasm may explain the obvious wall disturbances shown on roentgen study. Such cases were excluded. The line dividing superficial spreading carcinoma from the ordinary infiltrative variety as determined roentgenologically and by the gross examination is far from sharp.

Our material consisting of 6 cases is divided into two parts. The first is characteristically superficial spreading carcinoma pathologically and roentgenologically, and it consists of cancers giving either an entirely normal roentgen study or very minor roentgenologic findings. The second group is that with a pathologic description that appears to fit superficial spreading carcinoma, but the roentgenologic findings are perhaps somewhat more definite than one would generally expect to encounter were the lesion wholly a mucosal and submucosal one. Our major interest is in those carcinomas showing slight and at times puzzling and indefinite roentgen changes. It is our purpose to call attention to the possible grave significance of minor variations that the roentgenologist may encounter. We feel compelled to do this because of the poor success we have had when dealing with this morphologic form of stomach carcinoma in the past. Also, it seems that by better attention to technique and a greater alertness toward minor variations more instances of this disease can be recognized roentgenologically.

Three cases are presented, each selected to show increasing stages of stomach wall invasion and the roentgen appearances that result. The roentgen findings are given for each situation, and, taken together, constitute our concept of the roentgen diagnosis of superficial spreading stomach carcinoma.

REPORT OF CASES

CASE 1. S.L., a fifty-five year old white female, gave a history of pain in the lower abdomen of three months' duration and a ten pound weight loss. Two gastrointestinal roentgen studies done elsewhere were reported as negative (Fig. 1) ex-

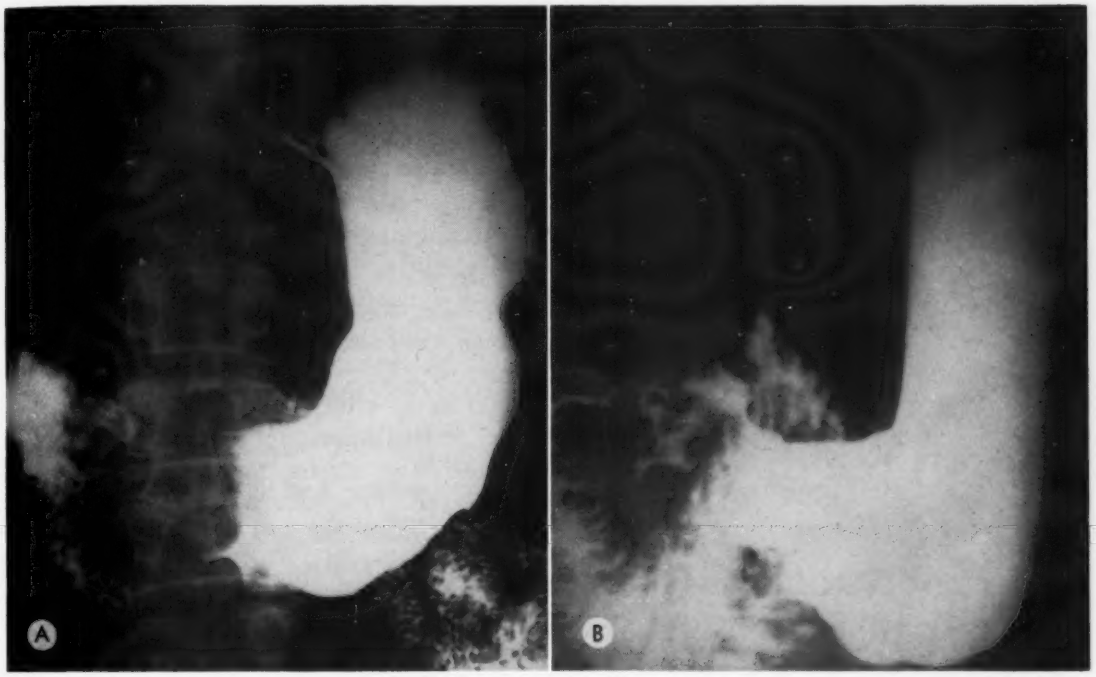

Fig. 2. Case II. (*A* and *B*) Two examinations done three months apart. Both reveal duodenal deformity with possible ulcer crater. Shown also is some paucity of stomach mucosal folds and shallow peristaltic waves.

cept for a diverticulum in the second portion of the duodenum. The patient, however, continued to lose weight and was anemic. Therefore, it was felt advisable to do an exploratory laparotomy. At operation, a carcinoma of the lesser curvature of the lower segment of the stomach was found. In order to effect the removal of the apparently grossly enlarged lymph nodes, a total gastrectomy with resection of the duodenum, the spleen, body and tail of the pancreas, lesser and greater omentum and the gastrosplenic ligament was required. The microscopic diagnosis was adenocarcinoma, largely confined to the mucosa, but showing fairly extensive submucosal lymphatic permeation.

Case II. F.R., a forty-five year old male, first came to Memorial Hospital in 1935 with an epidermoid carcinoma of the lower lip, which was treated successfully. In December, 1940, during a follow-up examination on his lip, he gave a history of espigastric distress, fullness after eating a small amount of food and a ten pound weight loss. These symptoms were of five months' duration. A gastric analysis showed an absence of free hydrochloric acid and blood was detected in the specimen. A gastrointestinal series disclosed thinned-out mucosal folds, particularly in the distal portion of the stomach. There was no evidence of any induration in the walls of the stomach. A reexamination of the stomach was recommended, with emphasis on a mucosal study. The second study was done nine days later and revealed a duodenal defect considered to be an ulcer with associated functional changes in the prepyloric region of the stomach (Fig. 2*A*). A third study done three months later again disclosed what seemed to be an active duodenal ulcer and functional changes in the distal stomach (Fig. 2*B*). Gastroscopy showed only an inflamed mucous membrane. The patient subsequently began to vomit and died within a few months. At autopsy the pathologist described a stomach of moderate size, with thickened walls and with nodules palpable in the wall. A carcinoma involving much of the stomach had spread into the duodenum, distorting the mucosa and accounting for the defect erroneously called an ulcer on the roentgenograms. The microscopic diagnosis was adenocarcinoma of the stomach, Grade 4, very diffuse with metastasis to the peritoneum, liver and lungs.

Case III. J.M., a sixty-one year old white female, dates her history back two years when she complained of belching and increased acidity as well as intermittent dull pain in the

FIG. 3. Case III. Obvious annular constriction in the prepyloric region is present in spite of the pathologic diagnosis of superficial spreading carcinoma.

epigastrium. She was subsequently treated for gallstones and placed on a fat-free, low meat diet. The above symptoms persisted, with the pain increasing in frequency and severity and occurring both before and after meals. A gastrointestinal series was done. She was placed on a milk and cream diet and received medication as well. The pain disappeared but the belching and flatulence persisted. A gastric analysis disclosed normal acidity and no evidence of blood or bile. The roentgen studies were repeated and she was then referred to Memorial Center for surgery. Submitted roentgenograms revealed a constricting lesion at the pyloric end of the stomach, which was strongly indicative of deep wall invasion, so that the roentgen diagnosis of an organic lesion seemed rather obvious (Fig. 3). At operation the surgeon stated that the patient had such a small carcinoma that it was not possible to determine it by palpation. Surprisingly enough, after the stomach was removed, the pathologist on gross examination of the specimen saw no abnormalities and the mucosa appeared to be normal except that the rugae were not prominent. However, microscopically, multiple small foci of superficial adenocarcinoma were found in the mucosa of this part of the stomach. There was no penetration of the muscularis mucosae. None of the lymph nodes contained metastatic carcinoma. The lesion, therefore, was an extremely early one and the diagnosis was much more obvious roentgenologically than on gross inspection. The patient has had no significant complaints since the operation and is alive and well after a period of ten years.

DISCUSSION

Obviously, some stomach carcinomas are not detectable by the roentgenologist because they are too small to cause any macroscopic alteration. In this regard one must never charge such an error in detection to the individual examiner but rather to the inherent limitation of the method employed. Few, if any, symptomatic carcinomas would fall into the truly nondetectable category. Also, a distinction must always be made between detection of any abnormality and its precise or histologic identification. It is the former that constitutes the unique value of roentgenology in the stomach disease. It must be evident that superficial spreading gastric carcinoma is the one form of stomach neoplasm that contributes to keeping the roentgenologist's detection score less than perfect.

As for the roentgen findings that may be encountered, peristaltic activity may be depressed, the wave sometimes being single and traveling slowly. A more striking feature, however, is in the configuration, the wave form being shallower than usual and asymmetric as it traverses the distal stomach. Its base is broadened with rounding of the edges so that sometimes the wave is quite deformed. However, changes possibly of more significance are those related to the fold pattern and naturally these are more satisfactorily depicted when a meticulous mucosal type examination is carried out. Nevertheless, the glimpses of the stomach lining obtained from conventional roentgenograms may indicate that some surface disturbance exists. These roentgenologic findings can be described under two headings, alteration of rugal architecture and disturbance of mucosal function.

There is a diminution in the number of

mucosal folds. This seems to be brought about by an erasure of most of the smaller folds and a decrease in the number and prominence of the major or longitudinal ones. Varying degrees of pressure, peristaltic action, change in the position of the stomach, may all fail to show the rugal appearance expected in the normal. Furthermore, the contours may be indistinct, thin and linear in course. Fold impressions along the greater curve may be lessened.

Alteration in mucosal motion is more evident on spot films exposed at roentgenoscopy. Peristaltic activity, distention of the stomach, change in the position of the stomach, palpation of the stomach walls with varying degrees of pressure, all indicate a "freezing" of the thinned mucosa. There is no parallel fold formation with the passage of the peristaltic wave.

There is no evidence of a general disturbance in stomach function such as increase of secretion, alteration in tone, evidence of spasm, motility derangement, or change in the mobility of the stomach. Tenderness is absent and there is no palpable mass.

DIFFERENTIAL DIAGNOSIS

The condition likely to cause difficulty in differential diagnosis would be certain cases of gastritis. In our experience with that form of gastritis simulating an infiltrating gastric carcinoma, the important differential points were the presence of a relatively large funnel-like contour defect with no palpable mass but with general functional changes. Tenderness over the stomach area, hypersecretion, abnormal peristalsis, spasm, and changes in motility were noted. These are not present with superficial infiltrating carcinoma.

CONCLUSIONS

1. Superficial spreading carcinoma is a very uncommon morphologic form of gastric neoplasm usually difficult or impossible to detect roentgenologically.

2. Detection requires meticulous technique with particular attention to findings of minor mucosal and wave form disturbance.

3. Selected cases from a group of 6 proved superficial spreading carcinomas are presented demonstrating the roentgen findings that may be encountered.

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JEJUNOGASTRIC INTUSSUSCEPTION*

WITH A REPORT OF A CASE

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JEJUNOGASTRIC intussusception is a grave though rare complication of gastrojejunostomy which is definitely recognizable by barium study of the upper gastrointestinal tract. Although over 100 cases have been recorded in the world medical literature, only a few cases have been reported in the radiologic journals[3,8] of this country.

REPORT OF A CASE

The patient, a fifty-four year old white female, was admitted to the Euclid-Glenville Hospital at 5:20 A.M. on May 28, 1957, with complaints of hematemesis and severe colicky epigastric pain of five hours' duration. This pain radiated to the left scapular region.

Past History. During the previous two years the patient had experienced several similar bouts of epigastric pain of shorter duration followed by spontaneous remission. On February 18, 1956, she was hospitalized when the pain was accompanied by hematemesis. At that time the barium study of the upper gastrointestinal tract revealed a normally functioning gastrojejunostomy and a constantly deformed duodenal bulb. All blood studies were within normal limits. The posterior gastroenterostomy had been performed at another hospital on June 26, 1953, because of the duodenal ulcer and secondary pyloric obstruction.

Physical Examination. The patient was obviously in distress. Her skin was cool and clammy. There was tenderness in the epigastrium and no mass was recognizable. The blood pressure was 130/80 mm. of mercury; the heart rate was 82, and the temperature 37°C.

Hospital Course. The patient was confined to bed. A Levin tube was introduced and usual supportive measures were applied, including a transfusion of whole blood. Although more hematemesis was reported, the total blood volumes were depressed only slightly, with a greater depression of the red blood cell volume to 1,213 cc. (normal, 1,909 cc.). On May 31, 1957, the upper gastrointestinal tract was examined by introducing a thin barium mixture through the Levin tube. Fluoroscopic and roentgenographic studies (Fig. 1 and 2) showed the stomach almost completely filled with gas dilated barium-coated loops of jejunum which displaced the tube to the left of the stomach lumen. These changes were obviously due to retrograde intussusception of jejunal loops through the gastroenterostomy stoma.

Surgery was performed on the same day after aspirating the barium from the stomach. Spinal anesthesia was administered and a midline incision was made between the xiphoid and the umbilicus. There were numerous dense adhesions which increased the difficulty of the procedure. A densely scarred duodenum was adherent to the head of the pancreas. This was freed in preparation for the proposed subtotal gastric resection. The small bowel was totally collapsed as was the large bowel, which accounted for the lack of distention. The posterior gastroenterostomy was located and about 18 inches of jejunum had intussuscepted into the orifice filling the greater portion of the stomach. These loops were easily dislodged by simple traction. The trapped jejunum was distended and edematous, but there was no evidence of necrosis. The jejunum was then divided on either side of the gastroenterostomy opening and anastomosed. A routine subtotal gastric resection of the Hofmeister variety was then performed. The patient made an uneventful recovery and has been asymptomatic since.

INCIDENCE

The first gastroenterostomy was performed in 1881, but the first case of retrograde intussusception of the jejunum was not reported until 1914 by Bozzi.[2] The second case was noted by von Steber[7] in 1917. In 1948 Aleman[1] collected 70 cases and in 1954 Palmer[6] compiled a bibliography of

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79 articles dealing with the subject. Caudell and Lee[4] found 19 additional articles and added 2 new cases in 1955. In 1956 Foster[5] also reported 2 cases and emphasized the surgical aspects of this entity. Thus, a few more than 100 cases of jejunogastric intussusception have been recorded in the world literature.

TYPES AND SYMPTOMS

In general jejunogastric intussusceptions are classified as acute and chronic. Many of the chronic forms are undoubtedly never diagnosed because they are self-reducing. The symptoms of the recurring chronic lesions may begin any time from five days to fourteen or more years after operation. These include epigastric pain, nausea and vomiting which recur at irregular intervals and are usually associated with meals. Chronic invalidism is seen with this type.

The acute form may result from incarceration of a chronic recurring intussusception as in the case reported above, or occur as an initial episode following gastroenterostomy. Acute intussusception is characterized by sudden onset and severe colicky epigastric pain which is followed by vomiting of food, then bile, and finally blood. The patient may be in shock. A mass may be palpable above and to the left of the umbilicus (recorded in over 50 per cent of cases).

Fig. 1. The anteroposterior roentgenogram of the abdomen demonstrates the intussuscepted jejunal loops in the stomach. Barium and gas outline the mucosal pattern of the intussusception which displaces the Levin tube laterally.

Fig. 2. The lateral roentgenogram of the abdomen confirms the rather extensive filling of the stomach by the intussuscepted loops of jejunum.

DIFFERENTIAL DIAGNOSIS

In differential diagnosis of both acute and chronic forms of jejunogastric intussusception, one must consider the possibility of marginal ulceration or recurrent peptic ulcer with hemorrhage or perforation, high intestinal obstruction due to adhesions, tumor, internal hernia, disease of the biliary tract, and acute pancreatitis. The three cardinal signs of mass, tenderness, and epigastric pain may be helpful, although a mass and tenderness may be

absent. Any patient who has had gastric surgery and subsequently develops severe epigastric pain or persistent vomiting (either bile-stained or bloody), or has a palpable epigastric mass, or tenderness over the epigastrium, or any combination of the preceding signs or symptoms, should be suspected of having jejunogastric intussusception until proved otherwise.

ROENTGEN FINDINGS

Barium study of the upper gastrointestinal tract is diagnostic of this entity. The roentgen signs of jejunogastric intussusception are given as follows: (1) The presence within the lumen of the stomach of a partially-moving filling defect, having lines of the normal jejunal pattern (Kerckring's folds or valvulae conniventes); (2) the reentry of the barium into the stomach by way of the afferent loop and stoma; (3) delay of gastric emptying; and (4) increase in size of the stomach.

ETIOLOGY

The cause of a retrograde jejunogastric intussusception is unknown. The type of gastroenterostomy or size of the stoma seem to be unrelated. Local spasm and reverse peristalsis may be factors.

TREATMENT

The only treatment for acute retrograde jejunogastric intussusception is immediate surgery. When the chronic form can be diagnosed, the treatment is surgical as well.

CONCLUSION

The case report of a patient who had an acute intussusception of the jejunum through the gastroenterostomy stoma resulting in incarceration and a surgical emergency is added to the literature. The need for early definite diagnosis is imperative and presents another instance where barium studies performed early in the patient's illness may lead to life-saving measures by demonstration of the specific lesion.

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DISPLACEMENTS OF STOMACH AND DUODENUM BY ANOMALOUS LOBES OF THE LIVER*

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RETROPERITONEAL tumors and carcinomas and cysts of the pancreas are usually considered in the differential diagnosis when the stomach and duodenum are displaced. Several cases which were seen recently in our department brought to our attention the fact that displacements of the stomach and duodenum can be caused by anomalous lobes of the liver.

Many cases have been described in which an accessory lobe of the liver caused a lobated projection of the right diaphragm superiorly and posteriorly.[4,6,7,8,11,12] This type of anomaly is the one most frequently seen by the radiologist since it is apparent in the ordinary posteroanterior chest roentgenogram.

Another type of anomaly is Riedel's lobe,[10] which is a downward, tongue-like projection of the right lobe of the liver, originally described as being secondary to gallbladder disease, but believed by many to be congenital. Riedel's lobe is frequently encountered as a palpable mass in the right upper quadrant. This may lead to surgical exploration since the mass is indistinguishable from a neoplasm. Occasionally, such a mass is observed roentgenographically. Gloyne[5] described a mass visible on roentgenograms, depressing the hepatic flexure, which at exploration proved to be a Riedel's lobe. An instance of an appendicular lobe (accessory lobe without gallbladder disease) was reported by Dick.[2] In this case a large palpable mass produced a persistent filling defect on the greater curvature of the barium-filled stomach. At operation the anomalous lobe was found to project from the mid-anterior surface across the stomach.

Other anomalies of the liver not pertient to the present discussion have been described.[1] Fraser[3] described a case of an accessory liver lobe on a pedicle with torsion leading to surgery.

The report of cases which follows illustrates changes apparent in the conventional upper gastrointestinal tract examination which were caused by various malformations of the liver.

REPORT OF CASES

CASE 1. C.McK., No. 1071–486, a forty-five year old Negro male, was admitted on numerous occasions to the Los Angeles County Hospital with diagnoses of chronic alcoholism, malnutrition, hypoproteinemia, Laennec's cirrhosis with ascites, pyoderma and hypertension. On December 22, 1954 the patient was admitted to the hospital for observation. An examination of the upper gastrointestinal tract was performed on January 6, 1955, at which time changes were noted in the distal esophagus, possibly representing small varices. It was also observed, however, that there was marked anterior displacement of the duodenal bulb suggesting the possibility of a retroperitoneal mass. The examination was repeated on March 16, 1955. The same changes were seen in the distal esophagus. Anterior displacement of the distal half of the stomach and the duodenal bulb with some distortion and displacement of the duodenal loop were again noted. At this time an epigastric mass arising from the pancreas or liver was suggested as the cause for the displacement (Fig. 1).

On April 21, 1955 operation was performed, consisting of vagotomy and pyloroplasty. The liver was described as being normal in size, markedly firm, nodular and typical of Laennec's cirrhosis. The quadrate lobe of the liver beneath the porta hepatis was hypertrophied to about 10 cm. in diameter and extended inferiorly 4.5 cm. The surgeon felt that this accounted for the anterior displacement of the duodenum as seen in the upper gastrointestinal examination. The head of the pancreas was of normal

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FIG. 1. Displacement of the stomach and duodenum by enlargement of the quadrate lobe of the liver.

size but markedly indurated, consistent with chronic pancreatitis.

The patient was last seen on September 26, 1955 and was doing well.

CASE II. R.M., No. 1548-211, a sixty-six year old white female, was referred to the Los Angeles County Hospital by her physician because of a possible intra-abdominal mass. She had been well until six weeks before admission, at which time she experienced lower abdominal distress. After a similar attack several years before, the patient had had an upper gastrointestinal tract examination at another hospital. According to the patient, the stomach was displaced to the left and anteriorly by an extrinsic mass. The patient was anemic and had lost 30 pounds. The bone marrow was normal. Ulcer management was instituted.

When the patient was admitted to the hospital, the liver was palpable one finger breadth below the right costal margin. The hemoglobin was 10.5 gm., the white blood cell count 7,600 per cu. mm. with a normal differential. Blood chemistry determinations including liver function tests were normal. An examination of the upper gastrointestinal tract was performed on January 19, 1955. A small hiatus hernia was found. In addition a large pressure defect was seen along the lesser curvature, and the stomach was displaced anteriorly (Fig. 2). Prominent mucosal folds were present in the region of the pylorus and duodenal bulb. It was felt that these changes were produced by a large pancreatic cyst.

At operation there was a 20 by 10 cm. mass, filling the lesser peritoneal cavity. It was attached by a wide pedicle to the extreme posteroinferior portion of the left lobe of the liver. The mass resembled liver tissue grossly. This impression was confirmed by microscopic examination of the biopsy specimen. The liver itself was approximately one-half normal size. Both lobes were identified, as was the gallbladder, which appeared normal. Three isolated yellow plaques were seen on the surface of the liver. On biopsy these were found to be sclerosing hemangiomata.

The patient made a satisfactory recovery and continues to have multiple vague complaints.

CASE III. L.B., No. 1533–793, a forty-seven year old white female, entered the Los Angeles County Hospital, having vomited blood on

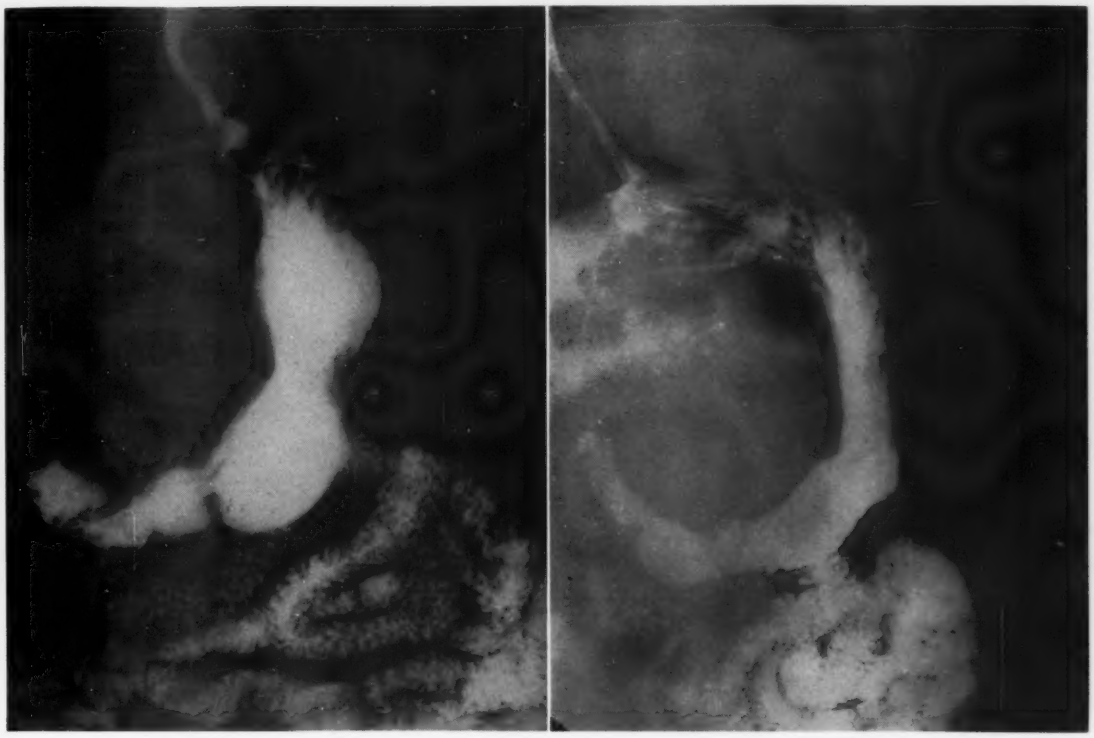

Fig. 2. Displacement of the stomach and duodenum by an anomalous lobe arising from the left lobe of the liver.

three occasions. The patient had had morning nausea and fatty food intolerance for years. Twelve years before she had had "an ulcer" with bleeding.

The hemoglobin on admission was 11.5 gm. After multiple transfusions this reached 15 gm. Liver function tests were normal. An examination of the upper gastrointestinal tract was performed on November 10, 1954. The esophagus was normal except for a moderately large hiatus hernia. The distal three-fourths of the stomach was unusually mobile and, with changes of position of the patient, was observed to "flop" from the normal left upper quadrant position to the right upper quadrant. The architecture and dynamics of the stomach were otherwise normal. The duodenal bulb and duodenal loop remained fairly fixed in position and the duodenal bulb was normal (Fig. 3). The patient was treated conservatively for hiatus hernia with bleeding and discharged from the hospital.

An operation was performed during a subsequent admission and revealed a widely patent esophageal hiatus. The stomach and transverse colon were on a long mesentery, allowing rotation of the stomach on its long axis. No left lobe of the liver or remnant of it could be found. The caudate lobe of the liver was present, and the right lobe of the liver was found lying to the right of the falciform ligament. Both of these lobes appeared normal. The gallbladder, spleen, small intestine and colon were also normal. An esophageal hiatal hernioplasty, vagotomy, and pyloroplasty were carried out. Postoperative diagnoses were esophageal hiatus hernia with upper gastrointestinal bleeding and congenital absence of the left lobe of the liver.

SUMMARY

It is well known that pancreatic and retroperitoneal masses can cause displacements of the stomach identifiable at gastrointestinal examination. Unusual and anomalous liver lobes can cause similar displacements and should be considered when such displacements are encountered. The 3 cases presented illustrate displacement of the stomach and duodenum by (1) enlargement of the quadrate lobe of the liver, (2)

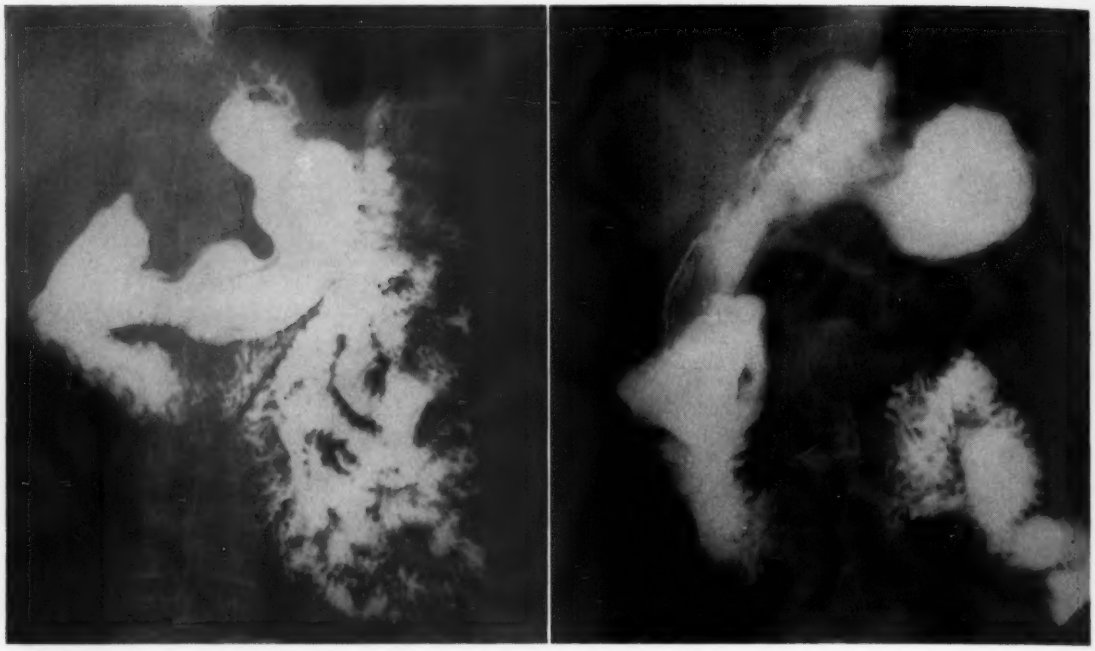

FIG. 3. Unusual mobility of the stomach due to absence of the left lobe of the liver. The duodenal bulb and duodenal loop are fairly fixed in position and the duodenal bulb is normal.

an anomalous lobe arising from the left lobe of the liver, and (3) absence of the left lobe of the liver. The latter is the third such case to be reported.[9]

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THE VATERIAN AND PERI-VATERIAN SEGMENTS IN PEPTIC ULCER*

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THE significance of an enlarged papilla of Vater with associated changes in the descending duodenum has been emphasized in chronic relapsing pancreatitis, acute pancreatitis, neoplasms in and around the vaterian segment and stones of the distal common bile duct.[2] Little attention has been devoted to the descending duodenal segment in peptic ulcerative disease, mostly of the duodenal bulb. This latter relationship serves as the basis for this paper.

ANATOMIC ASPECTS OF THE NORMAL DESCENDING DUODENUM AND VATERIAN STRUCTURES

On the posteromedial wall of the mid-portion of the descending duodenum, there is a longitudinal fold which crosses the valvulae conniventes at right angles. Located on this elevation is the major papilla into which open the common bile duct and the pancreatic duct (of Wirsung), either separately or together. The minor papilla (draining the accessory pancreatic duct of Santorini) is found about 2 cm. above and in front of the major papilla. In this study, the minor papilla will not be described in our clinical material. We are just beginning to apply our anatomic knowledge about the minor papilla to both the normal and abnormal subjects but these studies are in their preliminary phase.

In anatomic specimens, the major papilla is most frequently elliptic or cylindric in shape. The average dimensions of the major papilla are length—1.5 cm.; width—0.5 cm.; height—0.5 cm. However, the following variations in size may be encountered: length—0.1–3.0 cm.; width—0.1–1.2 cm. and height—0.1–1.2 cm.

Careful roentgen examination of the vaterian segment, in the routine upper gastrointestinal series including "spot films," is required for demonstration of the normal anatomic structures in the living and will frequently prove productive. In a series of 500 examinations of the upper gastrointestinal tract with orally administered barium, it was possible to detect the major papilla in 244 instances (48.81 per cent).[3] The major papilla is most often observed in the right anterior oblique and posteroanterior prone views although other projections may demonstrate this structure.

The location, size and shape of the major papilla as seen in the upper gastrointestinal tract examination correspond quite well with the data we have collated in our anatomic studies.[3] The major papilla is usually found on the medial wall towards its posterior aspect in the mid-portion of the descending duodenum. The papilla is characteristically oval with its greatest dimension in the direction of the long axis of the duodenum. Occasionally, the papilla exhibits a circular contour. The papillary margin is well defined, being associated with a normal surrounding mucosal pattern. The mucosa in the postbulbar region has a feathery appearance with irregular transverse folds increasing in prominence lower in the descending duodenum. Varying types of peristalsis may be seen in the normal state, including annular and segmental

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TABLE I

Type of Peptic Ulcer	No. of Patients
Duodenal bulb ulcer	22
Postbulbar ulcer	5
Duodenal bulb and postbulbar ulcer	1
Juxtapyloric ulcer	1
Gastric and duodenal bulb ulcer	1
Gastric ulcer	1

contractions, antiperistaltic activity and mild degrees of temporary stoppage in the mid-transverse duodenum (duodeno-mesenteric ileus).

CLINICAL MATERIAL

The material used in this presentation includes 31 patients who had a roentgenographic examination of the upper gastrointestinal tract with a final presumptive roentgen diagnosis of peptic ulcer of the duodenum. One patient with a benign gastric ulcer has been included. The average age in this group of patients was 49.8 years with a range of twenty-eight to seventy-six years. As expected, there was a predominance of males, with the division being 26 males and 5 females. The distribution of the types of peptic ulcer are listed in Table I.

The second portion of the duodenum was studied in all patients. The mucosal pattern and changes in peristaltic activity were recorded. The papilla of Vater was observed as to its size and the character of its border. The papilla was most frequently seen in the right anterior oblique prone projection. In some instances the frontal and lateral projections showed the papilla optimally. The major papilla was clearly delineated in all 31 cases. Two measurements were applied in this evaluation of the major papilla. The length was measured in the long axis of the second portion of the duodenum. A transverse measurement was considered representative of the width of the papilla. The papillary dimensions varied from 12 to 40 mm. in length and 5 to 21 mm. in width. The mean average length was 24 mm.; the mean average width was 11 mm. This group of patients with peptic ulcer showed a statistically significant* increase in the average size of the major papilla as compared with our normal figures. Measurements for each group are shown in Table II.

TABLE II

MEASUREMENTS OF THE PAPILLA OF VATER

	Normal (series of 500 cases)	Patients with Peptic Ulcer (31 cases)
Average length	1.5 cm.	2.4 cm.
Average width	0.5 cm.	1.1 cm.

Varying degrees of irritability, spasm, intolerance to barium and coarsening of the mucosal folds of the descending duodenum were noted in 29 of the 31 cases with peptic ulcer.

Representative roentgenograms in 10 of our 31 cases have shown characteristic findings of irritability, spasm and mucosal edema (Fig. 1–10). In all instances the enlarged, edematous major papilla was well delineated. No case histories are appended because they were more or less typical for peptic ulcer. In all cases, an ulcer niche was demonstrated. Although some of the patients ultimately underwent surgery (partial gastrectomy—usually of the Billroth II type), in no instance was the retroperitoneal descending duodenal segment explored since there was no indication, and since such exploration would have only increased the hazards of the surgical procedure. In several cases under medical treatment, the abnormal descending duodenal changes (particularly the edematous papilla) reverted to normal as the patients' symptoms subsided and the ulcer niche disappeared.

DISCUSSION

Otonello[1] in 1935, recorded the coexistence of an enlarged papilla and peptic

* The probability of the length, width and area of the major papilla in our peptic ulcer series being greater than in our series of normals, due to chance alone, is calculated to be in the order of 0.0001 (submitted by A. B. Siegelaub, statistician).

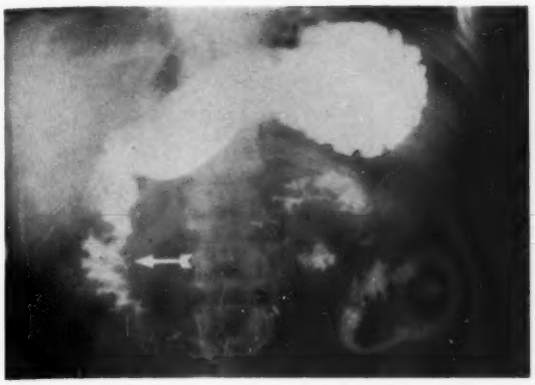

Fig. 1. The major papilla (indicated by the arrow) is enlarged and there is some coarsening of the surrounding mucosa of the second portion of the duodenum.

ulcer of the stomach and duodenum. Spasm of the sphincter of Oddi was suggested by this author as the primary process. He felt that the failure of adequate flow of pancreatic and biliary juices in the duodenum was followed by the development of peptic ulceration of the stomach or duodenum. Stiennon[4] reported an enlarged papilla in a case of duodenitis which regressed following medical treatment. He stated that the anatomic basis of the reversed 3 or epsilon sign of Frostberg was the enlargement of the minor and major papillae. In 9 patients reported by Teplick[5] with posterior penetrating duodenal ulcers and

Fig. 2. Slight change is observed in the mucosa of the descending duodenum associated with some enlargement of the major papilla.

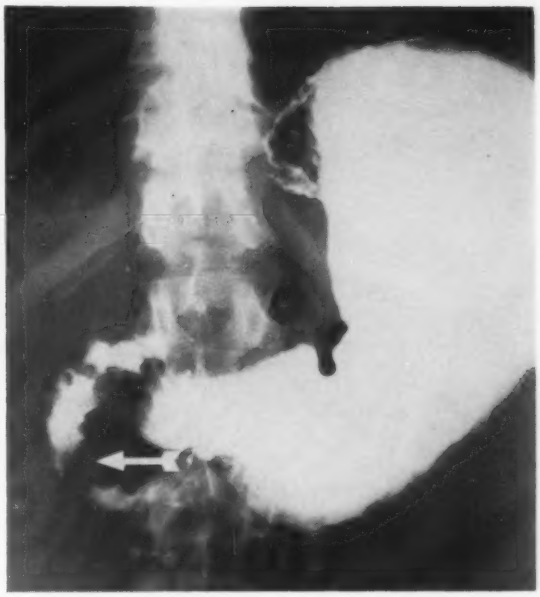

Fig. 3. The enlarged and sharply defined major papilla almost transects the descending duodenum.

Fig. 4. Although the duodenal loop mucosa is normal, there is slight enlargement of the major papilla.

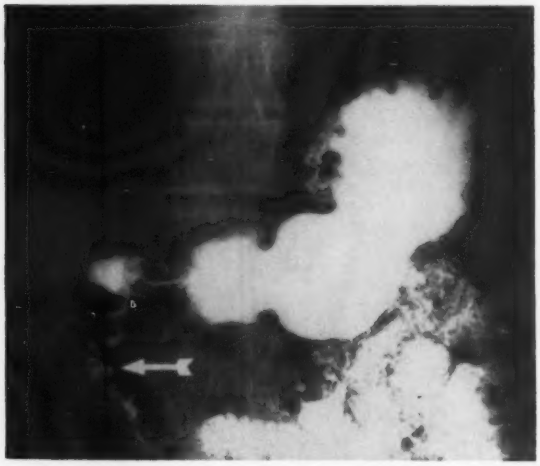

FIG. 5. Irritability of the duodenal loop is noted with coarsening of the mucosal pattern and enlargement of the major papilla.

roentgen demonstration of duodenal loop changes, 6 had surgical confirmation of penetration of the ulcer into the pancreas. Pancreatic inflammation secondary to the penetrating ulcer was considered responsible for the changes observed in the duodenal loop.

In our series, the changes in the vaterian and peri-vaterian region are felt to be definitely related to peptic ulcer. Although the demonstration of a niche remains the most reliable sign of peptic ulcer, an enlarged papilla accompanied by irritability,

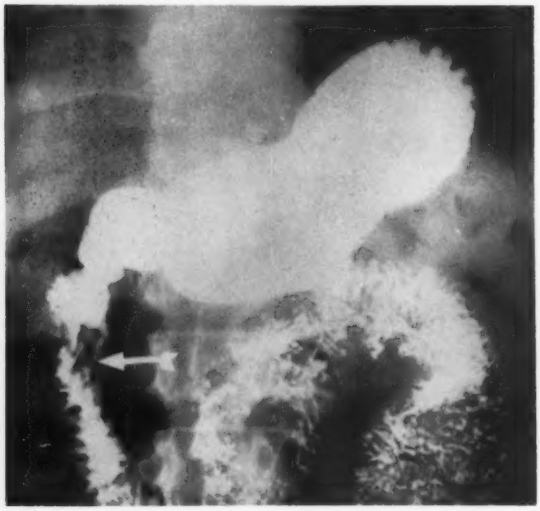

FIG. 6. Enlargement of the major papilla with some mucosal alteration of the proximal portion of the descending duodenum.

FIG. 7. Irritability of the second portion of the duodenum is associated with moderate enlargement of the major papilla.

spasm, intolerance and mucosal edema in the descending duodenum may direct one's

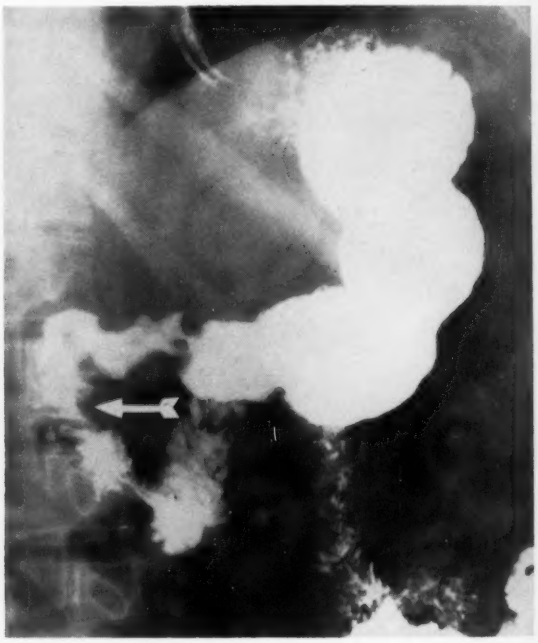

FIG. 8. Increase in size of the major papilla and segmental contractions of the descending duodenum.

attention to the bulbar and immediate postbulbar region when a niche is not initially seen. Such an observation may be particularly important in cases with "megabulbus" where the ulcer niche is not easily detected.

The finding of an enlarged papilla lacks specificity and a differential diagnosis must be made. The papilla may be enlarged in calculus disease of the distal common duct, pancreatitis and vaterian malignancies. The pathogenesis of an enlarged papilla is better understood when the following causes of papillary enlargement are considered:

1. Eccentric enlargement of the papilla (peptic ulcer). In duodenal ulcer there is diffuse enlargement of all the duodenal mucosal folds with the maximum enlargement occurring at the apex of the bulb. A gradual diminution in size of the enlarged folds is seen as we pass down the duodenum. The enlargement extends to and beyond the papillary region. The papillary fold will participate, and, since it is larger than the other folds, the papilla will obviously be that much more prominent.

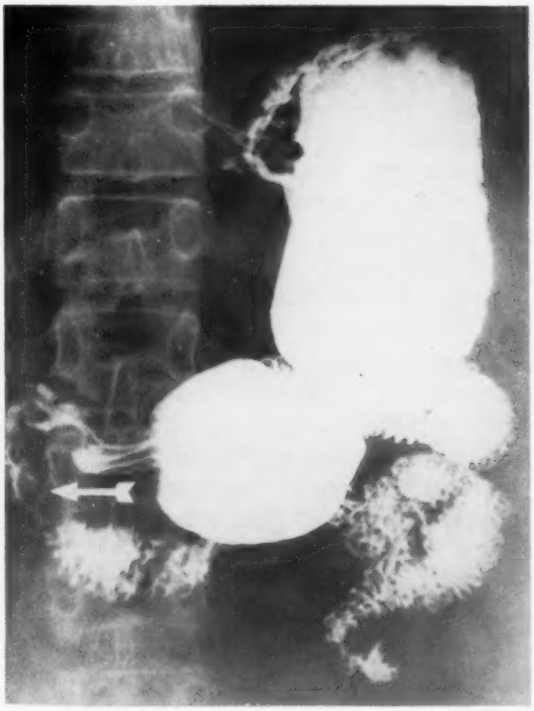

Fig. 9. The major papilla is moderately enlarged with some coarsening of the surrounding duodenal mucosa.

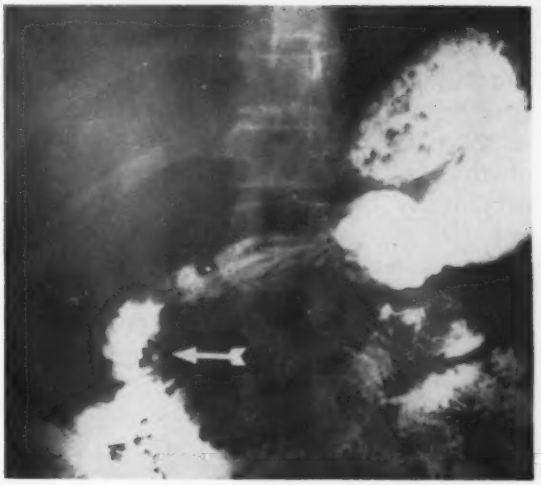

Fig. 10. Moderate increase in size of the major papilla with some enlargement of the duodenal loop, possibly indicating pancreatic edema. Irritability and segmentation of the third portion of the duodenum.

2. Centric enlargement of the papilla. (a) Calculus in the distal common duct. The papilla is enlarged with the enlarged duodenal folds gradually diminishing in size as we pass away from the papilla in all directions. There is no associated pancreatic enlargement or pancreatic calcification. (b) Pancreatitis. The papilla and the duodenal folds appear much the same as those described above in (a). However, there may be associated pancreatic enlargement, pancreatic masses and pancreatic calcifications. (c) Vaterian malignancy. There is a gradually irregularly enlarging papilla with no enlargement of the surrounding folds but often with some local erosion. Usually there is no enlargement of the pancreas, no pancreatic mass and no pancreatic calcification.

SUMMARY AND CONCLUSION

Enlargement of the papilla of Vater with surrounding mucosal alteration, spasm, intolerance and irritability of the descending duodenum has been described in peptic ulcer. The frequency of these changes in 31 cases of roentgenologically demonstrated peptic ulcer is noted and characteristic

roentgen findings are shown. The rather constant and significant enlargement of the major papilla is emphasized against the background of the other changes in the desending duodenum. Diligent examination of the descending duodenum roentgenographically for delineation of the papilla and the peripapillary area should be encouraged. A classification based on the papillary enlargement due to peptic ulcer, distal common duct stone, pancreatitis and vaterian malignancy is included.

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A TECHNIQUE FOR FILLING PART TWO OF THE DUODENUM WITH PARTICULAR REFERENCE TO THE IMPROVEMENT IN ROENTGENOGRAPHIC DEMONSTRATION OF POST-BULBAR ULCERS

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PEPTIC ulcers of the descending portion (Part II) of the duodenum are quite common.[6] Many of these lesions are not diagnosed roentgenologically either because the examiner does not keep the possibility in mind or because of the great difficulty in satisfactorily filling the second portion of the duodenum with barium. The literature contains several worthy articles emphasizing the difficulty in roentgenologic diagnosis, many cases of these so-called "post-bulbar" ulcers having been diagnosed at laparotomy[4,5] or at necropsy[3,7,8] following unsuccessful roentgenologic attempts at diagnosis. The unexpected discovery of such craters at laparotomy on the posterior wall of Part II of the duodenum has given rise to the name "duodenal ulcer occulta"[5] because roentgenologic and clinical examination has failed to demonstrate a cause for the severe abdominal pain, bleeding, or atypical biliary symptoms due to edema which may have partially occluded the common bile duct or ampulla of Vater. The purpose of this paper is to describe a method of improving our ability to roentgenologically diagnose these lesions.

There can be no doubt that routine methods of roentgenologic examination demonstrate some of these ulcers. However, even when spot roentgenograms and post-fluoroscopy roentgenograms are made in differing degrees of obliquity[1,2] in prone and upright positions, there will be a substantial number of cases in which, because of severe irritability and spasm, Part II of the duodenum will not be filled with barium, or will be so incompletely filled that differential diagnosis between neoplasm, diverticulum, and inflammatory lesion is impossible (Fig. 1 and 2). A repeat examination may result in a similar differential diagnostic impasse, unless the examiner can be successful in filling the lumen of the second part of the duodenum with barium.

Schatzki, in commenting about a paper by Lockwood, Smith, and Shook,[6] stated that in some patients it is very difficult to get enough barium into the second and third portions of the duodenum, but did not mention his method of doing this difficult task. I examine the entire duodenum routinely, and in the past have occasionally encountered patients in whom the second portion of the duodenum could not be filled at fluoroscopy. After a little trial and error, a method was devised (Fig. 3) of occluding the third portion of the duodenum distal to the suspected abnormal area, and then wait for the second portion to fill as a result of a few successive gastric and bulbar peristaltic waves, or as a result of manual expression of barium into the duodenum from the gastric antrum. The maneuver is carried out under fluoroscopic control and spot roentgenograms are made when the region under question has filled. Since beginning to use this technique, I have been encouraged by the clear-cut demonstrations of postbulbar peptic ulcers, and in the more accurate differential diagnosis of all lesions of the duodenum distal to the bulb. In patients with large, obese or muscular abdomens, the technique is understandably difficult, because of the great difficulty in using compression techniques.

The method is most easily performed with the patient in the prone or prone-

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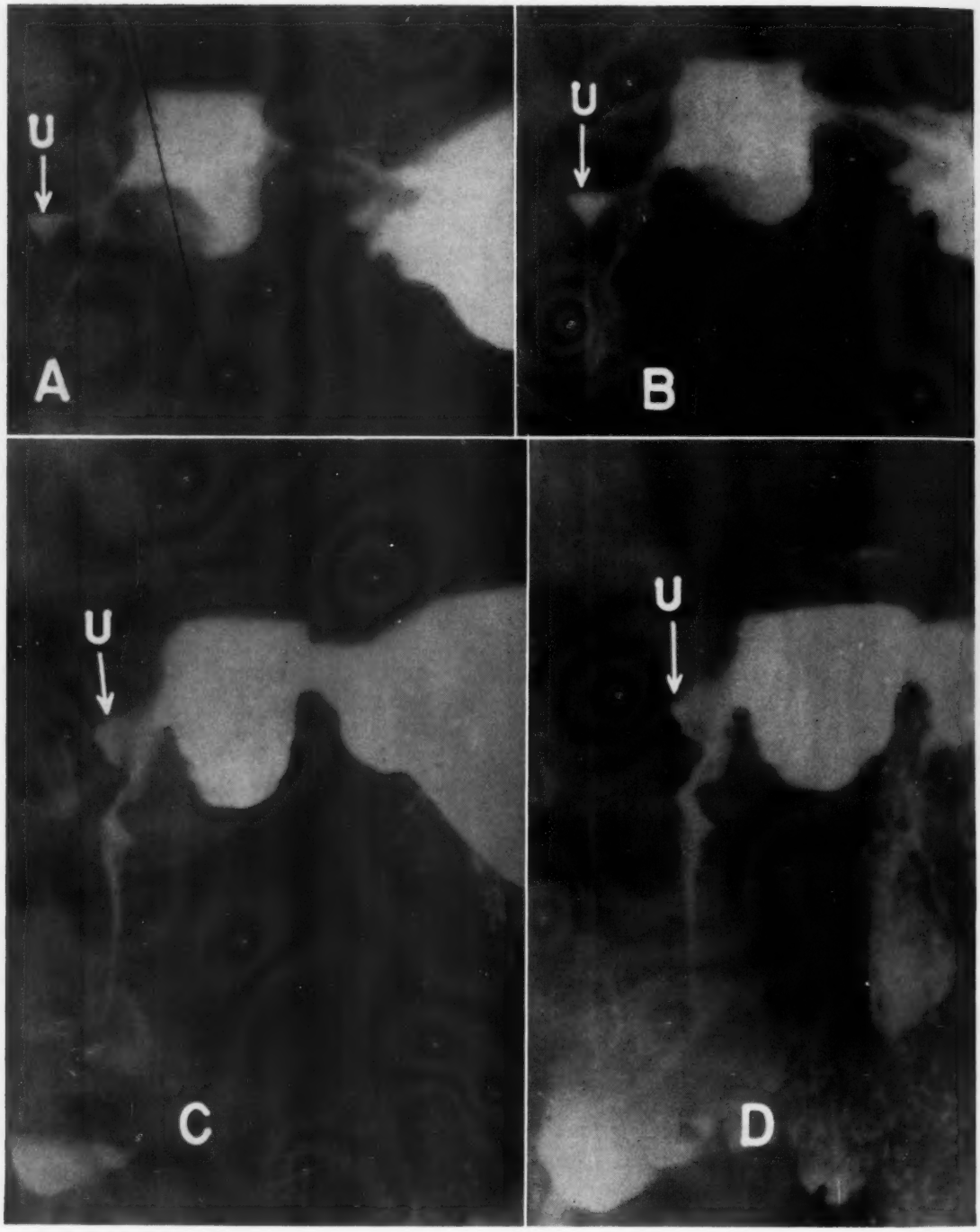

FIG. 1. (*A* and *B*) Upright roentgenograms which show what appears to be a postbulbar collection of barium diagnosed as a diverticulum by an experienced radiologist. (*C* and *D*) Routine upright roentgenograms of the duodenum made a few weeks later because of continued symptoms fortunately show better filling of the now obvious ulcer crater located in the apex of the duodenal bulb in the immediate postbulbar region. Note the extremely poor filling of the entire descending portion of the duodenum (Part II) on all of the roentgenograms, which is unfortunately a common occurrence when pathologic processes involve this part of the duodenum.

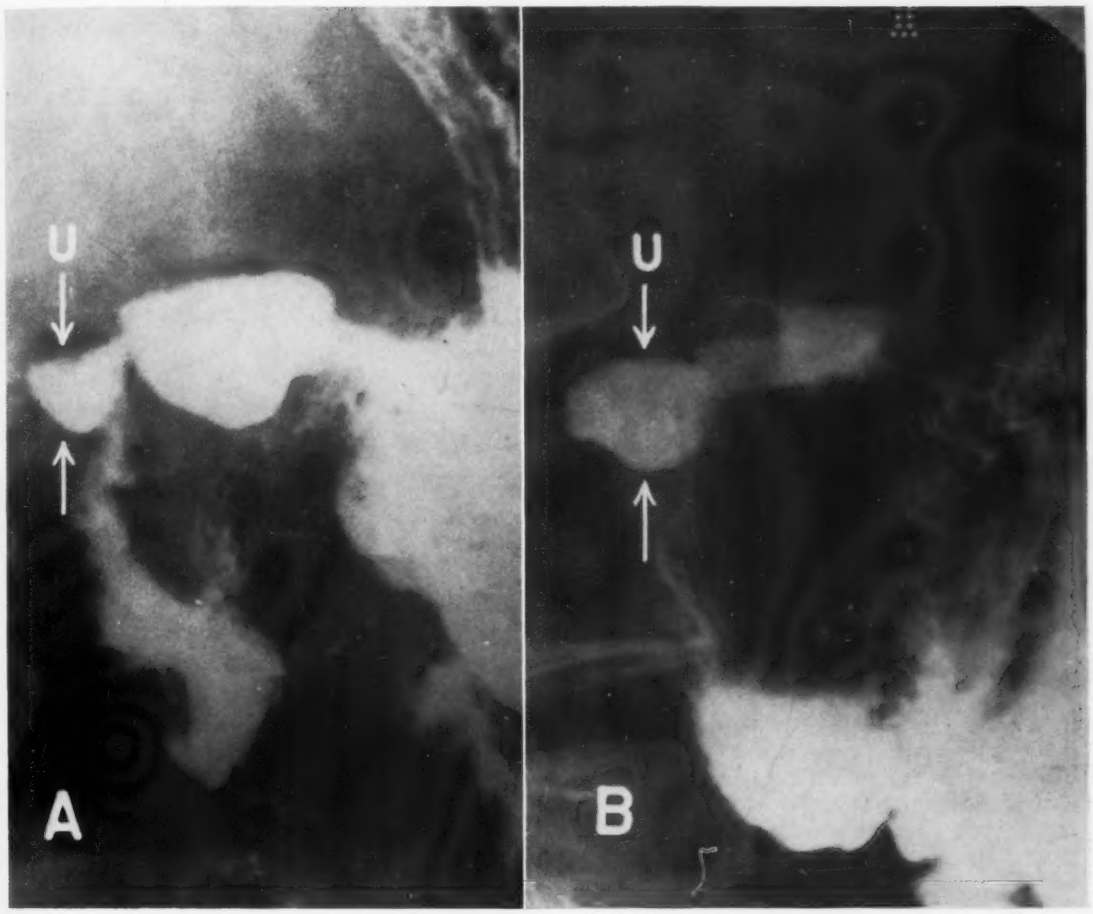

Fig. 2. (*A* and *B*) Upright roentgenograms of patient with melena, showing what appears to be as large diverticulum arising from the descending portion of the duodenum. An experienced radiologist believed it to be a diverticulum. The duodenum did not fill in the prone position. As seen on the above views, barium could be expressed into the second portion of the duodenum, but did not accumulate in amounts large enough to ascertain whether the lesion was a diverticulum or crater. (Figure 4 clearly shows the nature of the lesion at examination using the author's method of holding barium in the second portion of the duodenum.)

oblique position. The pads used for compression are made from ordinary surgical gauze wound into round or oval balls from 5 to 7 inches in diameter. Under fluoroscopic control one of these pads can be placed between the patient and the table so that when the patient's weight rests on the pad, the third portion of the duodenum can usually be occluded. The examiner can often place his gloved hand beneath the patient in order to manually express barium into the duodenum from the stomach, if gastric peristalsis does not accomplish duodenal filling. Sometimes it is necessary to spend an exasperating minute or two before success is evident. Small amounts of barium forced into the narrow spastic lumen at the site of the lesion will almost always pass through quickly without distending the lumen or delineating the pathologic process. These small boluses of barium can be made to accumulate distal to the lesion in Part II of the duodenum because of the compression applied over Part III. The barium which has accumulated distal to the lesion can then be forced in retrograde fashion into the diseased lumen and held there, particularly if the duodenal

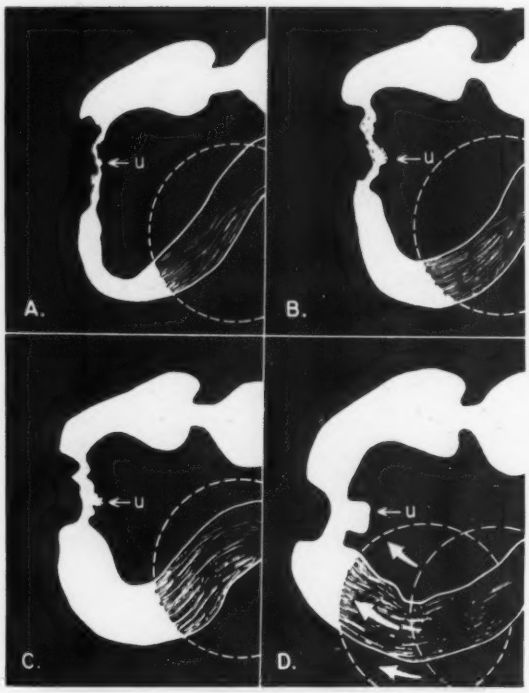

FIG. 3. Diagrammatic illustration of the technique of filling the second portion of the duodenum. (*A*) The compression block (white line) is directed against the third portion of the duodenum, with barium beginning to accumulate in the second part of the duodenum proximal to the compression. Lumen is not adequately filled for differential diagnosis between peptic ulcer and neoplasm. (*B*) After the duodenal bulb has forced small amounts of barium through the spastic lumen at the site of the ulcer crater, barium is trapped in the second portion of the duodenum and the disease process is a little better outlined. (*C*) Further accumulation of barium now fills the duodenum on both sides of the spastic area at the site of the ulcer crater. Lumen at site of crater is still spastic and not well filled. (*D*) Compression block is moved in retrograde fashion (arrows), thus forcing barium from the region distal to the lesion into the diseased lumen, which is then distended with clear-cut delineation of the ulcer (U).

bulb peristalsis also forces barium into the diseased area from the proximal side. Then the diseased lumen will fill completely and the pathologic process can be easily identified. Spot roentgenograms are always made under direct fluoroscopic control, following which compression can be released and additional spot roentgenograms made to show collapse of the lumen, mucosal fold pattern, etc., which should corroborate the diagnosis of an inflammatory lesion.

When examination in the prone position does not result in success, the maneuver can be tried in upright position, in which event it is necessary to use a pendulum type of compression device,[9] which allows compression to be directed eccentric to the center of the field of fluoroscopy (Fig. 3) or spot film, inasmuch as Part III of the duodenum may be well outside the area of interest in Part II. This maneuver is done without compression in the region of the lesion itself, which is fortunate, in the case of peptic ulcer, because of the frequently associated severe pain and tenderness due to the periduodenal inflammatory reaction which often involves the head of the pancreas.

I have successfully examined several patients using the previously described maneuver following prior nondiagnostic studies by experienced examiners using conventional methods. In Figure 2, *A* and *B* are seen spot film views of what appears to be a diverticulum distal to the duodenal bulb. The lumen from which the lesion projects is never clearly seen due to incomplete filling. The patient was re-examined

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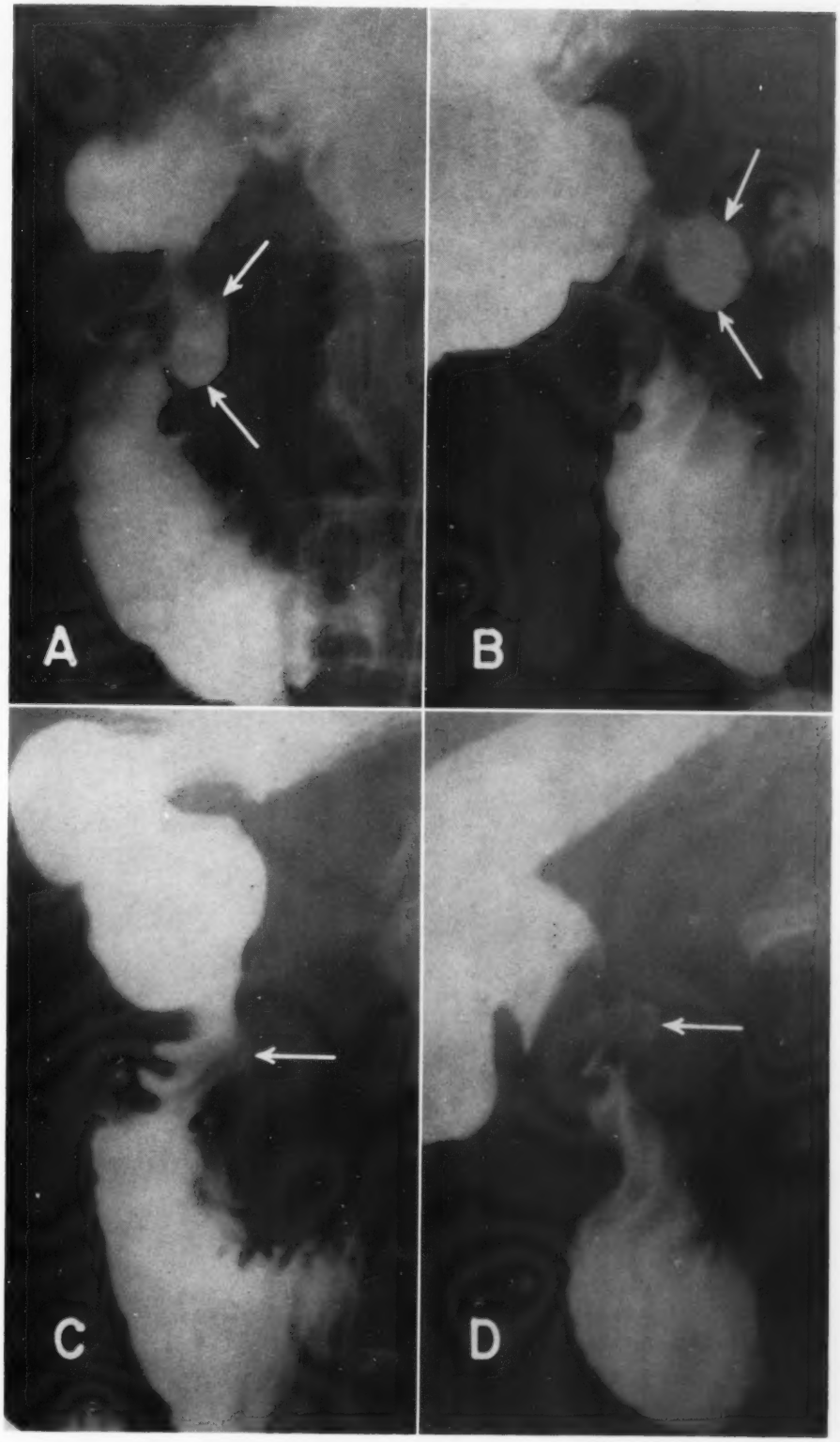
FIG. 4. (*A* and *B*) Roentgenograms made two days after first examination (see Fig. 2) now clearly identify the lesion as a large postbulbar crater rather than a diverticulum. (*A*) Upright spot roentgenogram, patient facing the examiner, with compression made over the third portion of the duodenum, most of which lies out of the field. (*B*) Exaggerated oblique view with tilt table in 45° semi-erect position, patient's left side toward fluoroscopic screen, and compression directed against duodenum distal to the ulcer crater. (*C* and *D*) Spot roentgenograms in almost identical views made at third examination a few weeks after *A* and *B* show considerable diminution in size of the crater. *C* was made in upright position with compression directed against the third portion of the duodenum, with clear delineation of the ulcer crater. This view demonstrates some distensibility of the lumen when compared to *D*, which shows the mucosal folds radiating toward the ulcer crater and contraction of the diseased portion of the duodenum following the release of compression on the third portion of the duodenum.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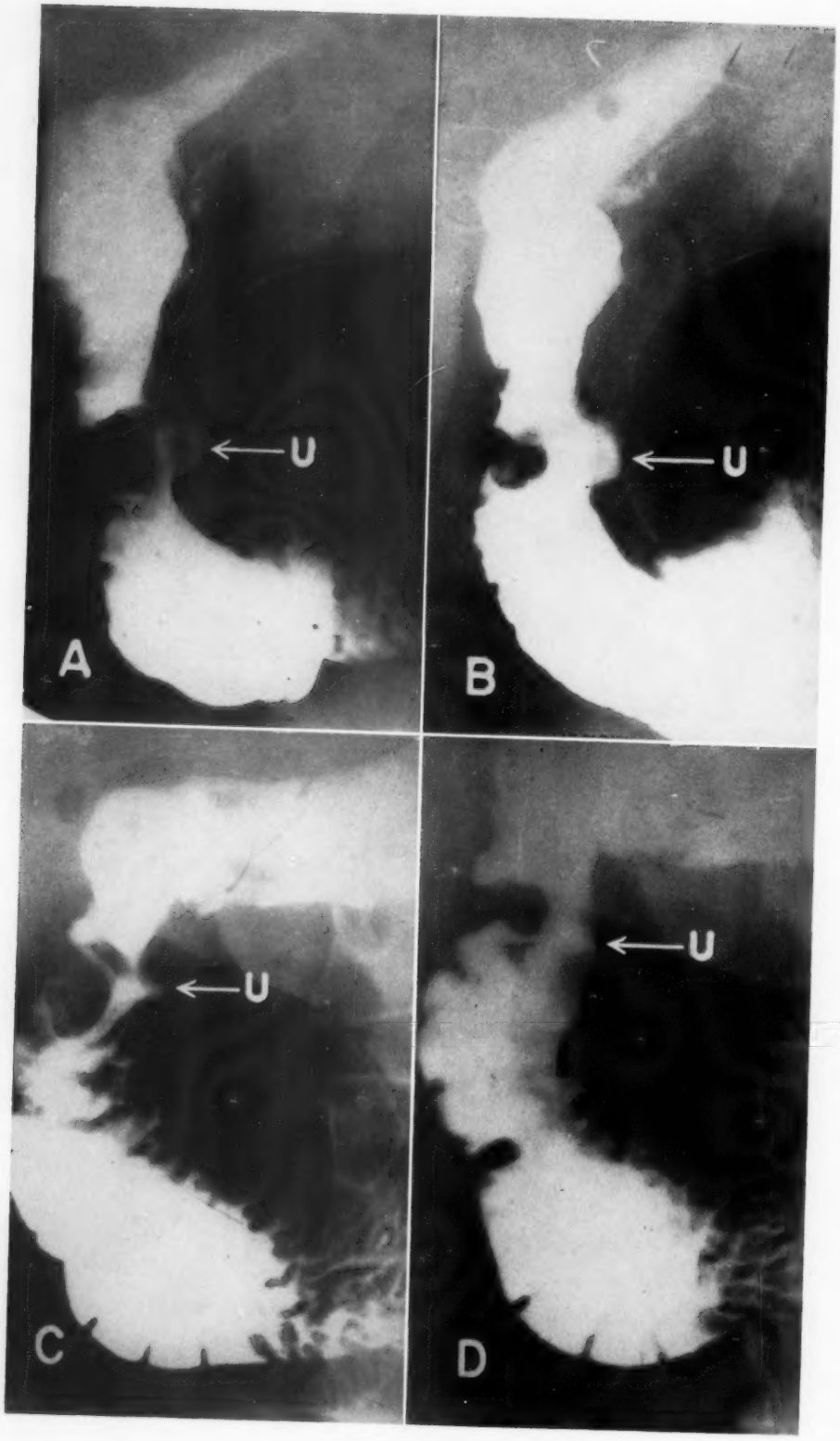
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two days later (Fig. 4, *A* and *B*) by the above described technique. The re-examination clearly shows a huge crater, rather than a diverticlum as had been previously diagnosed. Three weeks later (Fig. 4, *C* and *D*) following a strict medical regimen the crater had markedly diminished in size.

Often the irritability and spasm of the lumen prevent filling of the crater, and the narrowed irregular lumen may resemble a neoplasm of Part II of the duodenum. In one such case, re-examination using the previously described method clearly showed the lesion to be not a neoplasm, but a peptic ulcer crater (Fig. 5*A*). This re-examination resulted in complete visualization of the lumen, besides demonstrating distensibility of the lumen, in addition to showing the crater itself. A few weeks later, following strict medical regimen, the crater had almost completely disappeared, although some scarring remained (Fig. 5*B*).

The previously described cases are representative of the great difficulty in differentiating peptic ulcer of Part II of the duodenum from diverticulum or neoplasm. If the lesion is misdiagnosed as a diverticulum, the patient may be denied ulcer treatment, and further expensive time-consuming examinations or exploratory surgery may have to be carried out to explain his worrisome clinical findings. If the lesion is misdiagnosed as neoplasm, the patient may be exposed to an exploratory laparotomy before a medical regimen has been given a chance to heal the crater.

SUMMARY AND CONCLUSION

A simple, although sometimes difficult, roentgenographic method of examining Part II (descending portion) of the duodenum has been described. The method involves occluding the duodenum distal to the lesion by maintaining compression until barium accumulates in the diseased lumen in amounts adequate to fill it. This "trapped" barium can also be forced in a retrograde manner into the diseased area by manipulating the compression pads or pendulum compression device. Peptic ulcers of the second portion of the duodenum can almost always be clearly identified and easily differentiated from diverticula and neoplasms.

This method requires a little patience and manipulation during fluoroscopy, but will greatly improve diagnostic accuracy in many cases by clearly delineating the characteristic findings. The method is suggested only when routine methods fail to adequately fill Part II of the duodenum with barium.

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FIG. 5. This middle-aged adult male had melena. Previous conventional roentgenograms had shown a very poorly filled short segment of the second portion of the duodenum and had led to the impression of a carcinoma. (*A* and *B*) Subsequent roentgenograms using author's technique of filling the duodenum. The roentgenograms were made in the upright position with balsa wood pendulum type compression device directed against the third portion of the duodenum. In *A* barium has accumulated on both proximal and distal sides of the ulcer (U). Later in *B* the lumen filled adequately, clearly showing distensibility as compared with *A*, and clearly showing the crater (U), with characteristic "incisura" located opposite to the crater. (*C* and *D*) A few weeks later these roentgenograms were made in positions almost identical to those in *A* and *B*. Ulcer (U) has markedly diminished in size, but the "incisura" remains opposite the site of the crater.

Lesions in and about second portion of duodenum. Am. J. Roentgenol., Rad. Therapy & Nuclear Med., 1954, *71*, 573–580.

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ARTERIOMESENTERIC OCCLUSION OF THE DUODENUM*

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MUCH has been written about duodenal stasis and its etiology. One of the frequent causes is chronic intermittent occlusion of the duodenal loop due to compression of the third portion of the duodenum by the superior mesenteric artery at the point where it crosses over the loop with the superior mesenteric vein and nerve.[3] The author had the opportunity to examine 4 such cases within the past five years. All of these cases came to operation, exhibited similar findings and the same operative procedure was performed. All showed clinical improvement following surgery.

A common denominator of a strong psychic overlay in the symptomatology of 3 of these patients led to a review of the literature on the subject in an attempt to determine whether all patients with this anomaly behave identically and whether or not the problem is purely a mechanical one.

According to Bockus[3] the first to suggest the anomaly as an entity was von Rokitansky in 1849. Forty years later Glenard emphasized the importance of ptosis and gastric dilatation as the etiologic factors and believed that the superior mesenteric artery compression was physiologic to permit a better admixture of chyme with the duodenal juices. Connor in 1906 called attention to the relationship between acute dilatation of the stomach and chronic dilatation of the duodenum due to mesenteric compression.

Codman[5] was first to stress the underlying basis for the existence of the condition, attributing it to the upright position of man. Ptosis of the cecum and right colon were found in 19 out of 26 cases of duodenal stasis.[14]

ANATOMY

The transverse portion of the duodenum is the most fixed part of the entire alimentary canal. It is situated behind the peritoneum in contact with the aorta and the lumbar spine (usually L-3). Anteriorly it is in contact with the root of the mesentery of the small intestine which contains the superior mesenteric vessel sheath enclosing the artery, vein and nerve. In the postmortem specimen of an emaciated patient, there is a groove visible on the anterior wall of the transverse duodenum caused by its constant contact with the superior mesenteric vessels. This portion cannot escape compression in some patients because of its fixation. The right colic artery may arise anomalously higher off the superior mesenteric artery and cause similar constriction. Likewise, the mid colic artery may be responsible for the constriction if ptosis of the colon is present.[26]

Any contributing factor which lessens the space between the superior mesenteric vessels anteriorly and the aorta and spine posteriorly favors development of duodenal dilatation and stasis.[2]

SYMPTOMATOLOGY

Patients with mesenteric duodenal occlusion may vary in age from nine weeks[9] to the sixth decade.[29] The average is stated as forty-plus years.[3] The history frequently dates back many years, sometimes to childhood. The average duration of symptoms is eleven and one-half years.[2] Not infrequently, the patient with visceroptosis remains healthy until adult life, then symptoms may appear for the first time following weight loss from illness, some psychic trauma, severe emotional strain or repeated pregnancies. It has been reported

* Presented in part before the Forty-First annual session of The Pennsylvania Radiological Society, Pittsburgh, Pennsylvania, May 19, 1956.
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following application of a body cast[9] which exaggerated the lordotic spinal curve, and has been referred to as the cast syndrome.[11]

A comprehensive and incomplete list of symptoms includes: pain, belching, vomiting of bile, "gaseous indigestion" (fullness, bloating, discomfort), vasomotor and neuromuscular disturbances, borborygmus, flatulence and sense of weight in the abdomen after meals. Anxiety, tensional states and various grades of emotional instability are common. Occasionally, neurologic symptoms of vertigo, headache, neuralgic pains and malaise may dominate the general symptoms of digestive disturbances.[18,27]

PHYSICAL EXAMINATION

Almost all of the patients are of the asthenic habitus. Their abdomen is either flabby and pendulous or scaphoid and emaciated. Lordosis is common. The right kidney is usually palpable. Occasionally, hyperactive peristaltic waves are observed on the abdominal surface. Pressure over the lower abdomen to lessen the pull on the mesentery may at times give relief. The knee-chest position is said to also have brought instant relief in some patients.

ROENTGENOLOGIC EXAMINATION

The diagnosis of mesenteric artery occlusion of the duodenum can be suspected clinically and confirmed by roentgenographic examination.[7] This can best be done during an attack because there are periods when duodenal emptying may be temporarily satisfactory and the marked dilatation may not be discovered.

There are several criteria which must be fulfilled to establish a roentgen diagnosis: (1) There should be a constant dilatation of the duodenum proximal to the mid part of the transverse portion corresponding to the point of contact with the superior mesenteric artery sheath (Fig. 1); (2) there should be normal duodenum demonstrated distal to this site (Fig. 2); (3) there should be retention of barium beyond the normal time limit (Fig. 3); (4) to-and-fro movements of barium should be seen within the duodenal loop (Fig. 4). Other frequently associated findings include: (1) Dilatation of the pylorus and stomach (Fig. 5); (2) ptosis of the colon and small intestine (Fig. 6); (3) ptosis of the right kidney (Fig. 7); and (4) passage of barium beyond the obstructive site which may be aided by exerting manual pressure on the lower abdomen in a cephalad direction while the patient is in a prone position (Hayes maneuver).

LABORATORY FINDINGS

Laboratory studies are not diagnostic. About half of the patients show hyperacidity and half hypoacidity. Secondary anemia is usually present and the blood chemistry reflects only dehydration from excessive vomiting.

COMPLICATIONS

Duodenal ulcer or gastric ulcer was found in 25 per cent of 75 surgically proved cases of superior mesenteric artery occlusion.[28]

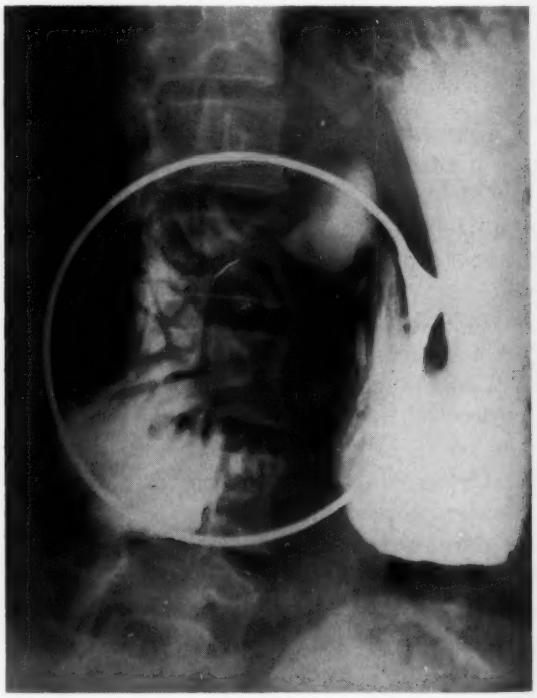

Fig. 1. Dilatation of the duodenum proximal to the site of crossing by the superior mesenteric vessels is a constant finding.

In an analysis of 264 cases of duodenal ulcer, an associated partial obstruction of the duodenum was found in 52.[24] Cholecystitis and hemorrhagic pancreatitis are not related to duodenal stasis.[2] Esophagitis has been reported and is thought to be secondary to prolonged vomiting.[17]

DIFFERENTIAL DIAGNOSIS

The conditions which are to be considered in the differential diagnosis are:

1. Congenital peritoneal bands which can produce similar obstructive changes but are exceedingly rare in adult life.

2. Shortening and thickening of the ligament of Treitz which is rarely a cause, and its location is distal to the site of arteriomesenteric obstruction.

3. Atresia of the distal duodenum and annular pancreas which manifest themselves very early in life.

4. Extreme ptosis of the duodenum and anomalies of malrotation which give rise to volvulus producing obstruction and are rarer possibilities to be considered, but do occur. We had one such case in which the duodenum was intraperitoneal with a mesentery and had produced a volvulus. The roentgen appearance was very similar.

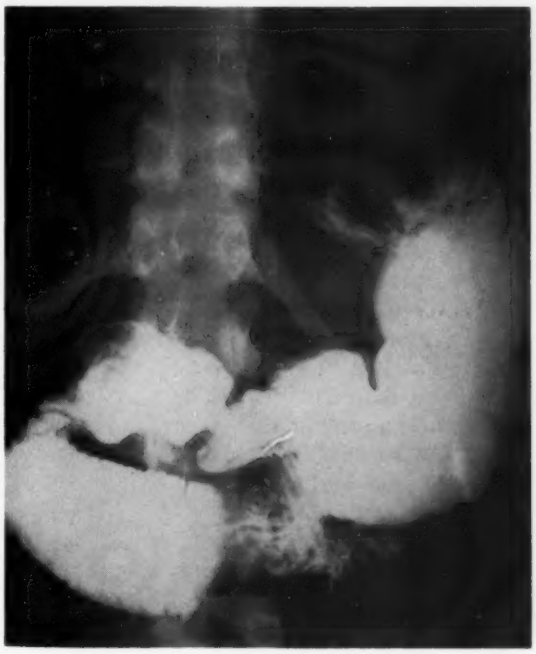

Fig. 2. Normal mucosa demonstrated distal to the site of obstruction by the superior mesenteric vessels is a constant finding.

Fig. 3. Roentgenogram demonstrating retention of barium in the duodenum beyond the normal time limit (six hour film). This must be constant to fulfill the diagnostic criteria.

5. Tumors and cysts of mesenteric and renal origin which compress the duodenum and produce filling defects or displacement and which are fairly characteristic roentgenologically.

6. Aneurysms of the abdominal aorta which in this region can produce obstructive phenomena, although they are very rare (1 reported in 1906[2] and 1 in 1936.[1])

7. Enlarged retroperitoneal lymph nodes such as observed in lymphomata and sarcomata which are usually associated with displacement and extrinsic pressure elsewhere in the loop. The clinical history is comparatively short and usually progressive, rather than intermittent.

8. Benign tumors,[6] primary carcinoma,[4,8] and tuberculosis[12] located in the transverse portion of the duodenum which may produce a roentgen appearance very similar to that of mesenteric artery ileus. The demonstration of intraluminal filling defects

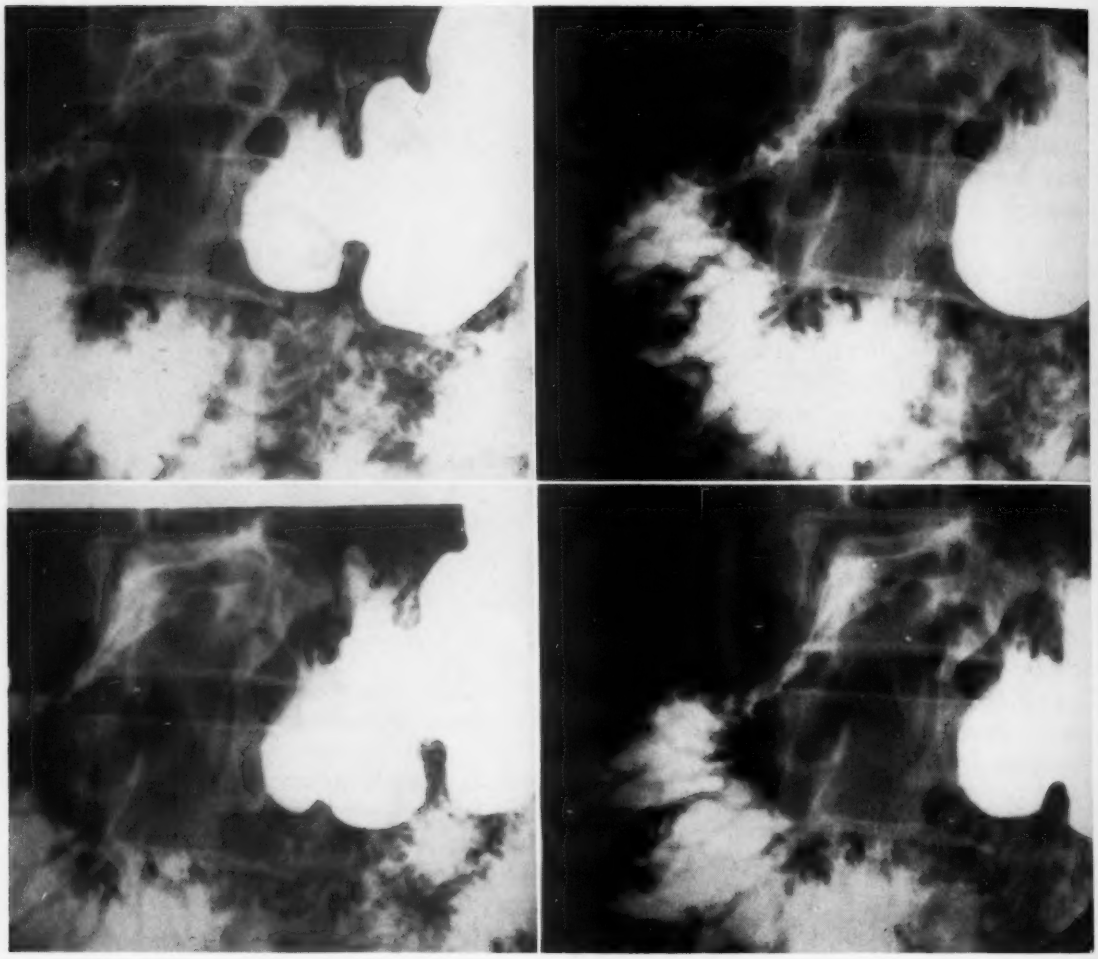

FIG. 4. To-and-fro movements of barium are observed within the duodenal loop proximal to the obstructing site. This is best seen fluoroscopically. Note the scarring in the cap from previous ulcer crater.

will help differentiate them from arteriomesenteric occlusion.

9. Idiopathic megaduodenum[13] which is found in infants and is usually not sharply demarcated at the mid-transverse portion of the duodenum.

REPORT OF CASES

CASE I. A thirty-three year old crane operator of sthenic habitus, height 5 feet, 8 inches, weight 165 pounds, complained of fullness and bloating after eating with a sensation of a heavy weight in his upper abdomen for one year. He rarely vomited and was not relieved by changes in position, and stated that his rest has been recently disturbed. He was admitted to the hospital on August 23, 1951 with sudden onset of nausea, vomiting and diarrhea. A similar attack one week previously had lasted one day. He was treated for acute gastroenteritis and discharged after three days. No roentgen examination was done.

On September 17, 1951 the nausea and vomiting returned with occasional diarrhea and severe upper abdominal pain. On re-admission to the hospital an upper gastrointestinal series revealed the roentgen features of arteriomesenteric occlusion of the duodenum (Fig. 4). At operation on September 20, 1951 a duodenojejunostomy was performed and the patient was discharged nine days later after an uneventful postoperative course.

CASE II. A twenty-eight year old secretary was admitted January 10, 1954 with the history of epigastric burning, pain and gaseous eructation. Symptoms had been progressive during

Fig. 5. Dilatation of the pylorus is frequently seen.

the past two years with short periods of partial relief. In 1950 she experienced the same symptoms to a lesser degree in intermittent attacks which were relieved by food. She lost 35 pounds between 1950 and admission. Her present weight was 113 pounds. Symptoms increased in intensity and persistence, were constant throughout the day, and awakened her at night. They were temporarily relieved by small frequent feedings.

Fig. 6. Ptosis of colon and small intestine is common. Note the active ulcer crater in the cap which is also a commonly associated finding.

Fig. 7. Ptosis of the right kidney is frequent. Note also the very low position of the transverse colon.

Physical examination revealed a scaphoid abdomen which was very tender in the epigastrium and exhibited hyperactive peristaltic waves. All laboratory studies including two gastric analyses were within normal limits. Intravenous pyelography showed ptosis of the right kidney. The upper gastrointestinal series revealed constant dilatation of the duodenal loop proximal to the mid transverse portion. The duodenal cap showed evidence of old if not current ulcer disease. The colon and small intestine were very ptotic and the right kidney was low (Fig. 6 and 7).

This patient had a strong psychic overlay in all of her symptomatology. She was divorced with the custody of a seven year old daughter whom she had to support. Her father had died of pneumonia complicated by peptic ulcer disease and both grandparents had died of cancer of the gastrointestinal tract.

On January 19, 1954 laparotomy was done and a duodenojejunostomy was performed. She had an uneventful postoperative course and was discharged twelve days later.

Case III. A fourteen year old girl was admitted to the hospital on November 10, 1954 with a history of having had sharp, intermittent, abdominal pain with nausea for one week. The day of admission vomiting occurred which later became coffee-ground and led to her hospitalization. Physical examination revealed a pale, thin girl of about 85 pounds, 5 feet in height. She had a diffusely tender abdomen but no rigidity or muscle guarding. Some peristaltic waves were visible on the skin surface in the epigastrium. Her laboratory studies showed only a mild anemia (red blood cells 3,800,000 and hemoglobin 10.5 gm.). She was given a transfusion of 500 cc. of whole blood.

Prior to the onset of symptoms the patient experienced a severe psychic trauma.

An upper gastrointestinal series was done and the findings fulfilled the criteria for a diagnosis of arteriomesenteric occlusion. In addition, there was marked narrowing of the prepyloric region of the stomach and moderate hypertrophy of the gastric mucosa.

On November 12, 1954 a duodenojejunostomy was done. The patient was discharged ten days later clinically improved.

Case IV. A thirty-one year old office worker and housewife was admitted on January 1, 1955 with a history of continuous vomiting for three weeks. She had had one similar attack four months before which had lasted ten days and was associated with severe epigastric pain and tarry stools. Bed rest for ten days and an ulcer regimen for six weeks brought relief.

Physical examination showed a thin female of lordotic posture, 5 feet 10 inches tall, weighing 108 pounds, with some tenderness in the epigastrium and no other significant finding. Laboratory studies were within normal limits. Roentgen findings of examination of the upper gastrointestinal tract fulfilled the criteria for a diagnosis of arteriomesenteric occlusion (Fig. 1, 2 and 3).

At operation on January 3, 1955 a duodenojejunostomy was done and recovery was uneventful.

All of the above cases were operated upon by different surgeons and all described their findings in a similar way. The only apparent cause for the dilatation of the duodenum was the extrinsic pressure from the superior mesenteric artery. The duodenum was opened and a finger was inserted into the transverse portion and all described the marked narrowing and the palpable pinch-cock action caused by the simultaneous plusations of the aorta posteriorly and the superior mesenteric artery anteriorly.

TREATMENT

When the roentgen criteria have been fulfilled for a diagnosis of arteriomesenteric occlusion of the duodenum, medical treatment is indicated until all resources are exhausted. In the seriously ill patient there should be complete bed rest with initial treatment identical with that given for pyloric obstruction. Measures are directed toward the relief of vomiting and the correction of dehydration, electrolyte imbalance, hyperazotemia, nutritional deficiency, anemia, etc. Every effort should be made toward reducing the pressure of the root of the mesentery on the duodenum. Long periods of bed rest with elevation of the feet 12 to 18 inches are indicated. Raising the lower abdomen and placing a pillow under the buttocks may be tried. The knee-chest position held for fifteen or more minutes after eating may also be helpful.

After the acute attack subsides, an ulcer regimen may be started—avoiding types and quantities of foods that cause gastric or duodenal dilatation. As soon as the physical strength permits, an appropriate abdominal support should be applied and abdominal and postural exercises should be begun. This is followed by a gradual increase in activity and in the length of time the patient is permitted to be in the upright position. Dietary management should then be directed toward weight gain.

If careful medical therapy is unsuccessful, surgery becomes necessary. Duodenojejunostomy is apparently the procedure of choice.

COMMENT

The earliest classic description of arteriomesenteric occlusion of the duodenum was by Wilkie[28] and the disease has been re-

ferred to as "Wilkie's syndrome."[7] He found duodenal dilatation at autopsy but could find no specific symptom in the history that could be correlated with the pathologic condition. He noted that moderate duodenal obstruction could persist for years without symptoms sufficient to incriminate the lesion until finally a complete obstruction supervened with symptoms too obvious to be mistaken.[29] He pointed out that when at operation the duodenum was found to be dilated but there was no very obvious obstructing cause visible, duodenojejunostomy gave "most uncertain" results. Often, an early improvement was followed by recurrence of symptoms. Dilatation of the duodenum could for some unknown reason be present without any detectable mechanical obstruction. When the obstruction was complete, the short circuiting operation produced excellent results. Wilkie warned against hasty surgery and recommended complete exhaustion of medical therapeutic measures before operation is contemplated.

Other writers[15,16,30] have further emphasized the advisability of careful medical management and complete clinical study before resorting to surgery. However, very few cases are reported which have not undergone surgery.[18,23] Many investigators[19,21,25] are of the opinion that duodenojejunostomy is the preferred operative procedure, although more recently, gastrojejunostomy[22] and gastric resection[10] have been recommended.

Far too little attention has been paid to the medical and psychiatric aspects of this disease. Several authors[18,20,30] emphasize this and report cases which have been cured by dietary and postural measures.[18] It would seem, that the varied digestive symptomatology, the frequency of neurologic symptoms and the psychic aspects of the complaints in these patients are much more than suggestive of the fact that the anatomic relationship of the superior mesenteric artery to the duodenum and the pull of the mesentery of a ptosed small intestine are only a part of the syndrome which deserves a more critical approach in its management.

SUMMARY

Occlusion of the duodenum by compression of the superior mesenteric artery where it crosses the transverse portion has been established as a cause of duodenal stasis. It is most frequently seen in the asthenic patient with lordosis. The traction of the mesentery is, therefore, believed to be a factor in the etiology. The majority of these patients have a variety of digestive complaints. Neurologic symptoms are sometimes prominent and the condition is very commonly precipitated by severe emotional strain.

The criteria for roentgen diagnosis are set forth and other findings frequently associated are mentioned.

Four cases are briefly reported which were confirmed by surgery and treated by duodenojejunostomy.

It is believed that many of these patients will respond to medical and postural treatment assisted by psychotherapy, and that the problem is not simply a mechanical one which can be cured permanently by some short circuiting operative procedure.

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Vol. 79, No. 5

THE PREOPERATIVE ROENTGEN DIAGNOSIS OF MECKEL'S DIVERTICULUM IN ADULTS*

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MECKEL'S diverticula are found in 1 to 2 per cent of all necropsies,[6,23,25] yet the diagnosis is seldom made by roentgen examination. A review of the English language literature discloses detailed reports of only 33 instances wherein a roentgen diagnosis of Meckel's diverticulum was made preoperatively.[2,4,7,10–17,20,22,24,28–31,33–36,38,40–42,47–49,52] However, we believe that if one is reminded from time to time that Meckel's diverticula can be demonstrated roentgenographically the diagnosis can be made more frequently than one might appreciate from the relatively few cases reported, particularly if proper selection for carefully detailed study is made of those cases in which clinical features suggest the possibility of Meckel's diverticulum.

We are reporting 4 cases in which the correct roentgen diagnosis was made preoperatively, and a fifth case in which the roentgen diagnosis was made but the patient has not yet been operated upon.

EMBRYOLOGY

During the early weeks of intra-uterine life, the amniotic cavity develops on one side of the embryonic disk and the yolk sac develops on the other (Fig. 1*A*). By the end of the fourth week the amniotic cavity has completely surrounded the embryo except for that portion of the body stalk (umbilical cord) which connects the embryo with the placenta (Fig. 1*B*). By this time the infolding of the elongated embryonic disk has divided the yolk sac into two cavities; a larger cavity, the digestive tube (primitive gut) of the embryo, and a smaller cavity, the yolk-sac vesicle (umbilical vesicle) near the placenta. These two cavities are joined to one another by a relatively long and narrow tube, the vitelline duct (omphalomesenteric duct), which is for the most part enclosed in the umbilical cord (Fig. 1*C*). The vitelline duct is usually obliterated by the seventh week,[52] but in some cases the obliteration is faulty and several types of anomalies may develop, as outlined in the following classification (modified from Caplan and Badner[10]):

A. *A fistula between the umbilicus and the ileum*, when the entire intra-embryonic portion of the vitelline duct remains as a patent tube.

B. *An umbilical sinus*, when only the distal portion of the intra-embryonic vitelline duct remains as a patent tube.

C. *A persistent fibrous cord between the ileum and the umbilicus*, when the intra-embryonic vitelline duct persists but does not remain patent.

D. *A Meckel's diverticulum*, when only the proximal portion of the intra-embryonic vitelline duct remains patent, with or without persistence of the rest of the intra-embryonic vitelline duct as a fibrous cord from the tip of the diverticulum to the umbilicus.

E. *Multiple combinations of A to D.*

ANATOMY

Meckel's diverticula usually arise from the ileum between 1 and 3 feet from the ileocecal valve.[5] It is claimed they may occur anywhere in the ileum or even as Nygaard and Walters[37] have expressed it, anywhere "from the (gastric) cardia to the rectum." However, Kump *et al.*[29] believe that those "diverticula" arising far from the usual ileal site for Meckel's diverticula actually represent instances of intestinal duplication. These authors have pointed out that intestinal duplication, which is unrelated to the vitelline duct, is almost

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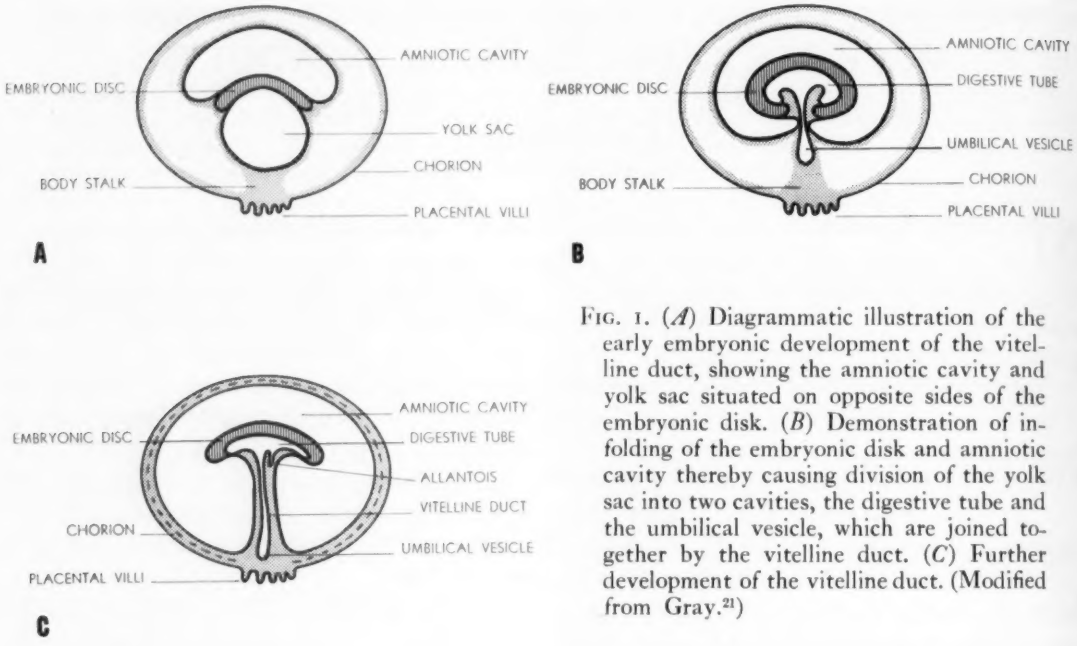

FIG. 1. (*A*) Diagrammatic illustration of the early embryonic development of the vitelline duct, showing the amniotic cavity and yolk sac situated on opposite sides of the embryonic disk. (*B*) Demonstration of infolding of the embryonic disk and amniotic cavity thereby causing division of the yolk sac into two cavities, the digestive tube and the umbilical vesicle, which are joined together by the vitelline duct. (*C*) Further development of the vitelline duct. (Modified from Gray.[21])

always on the mesenteric side, whereas Meckel's diverticula characteristically arise from the antimesenteric side of the intestine.

Intestinal duplication probably also explains some of the reported cases of so-called Meckel's diverticula of unusual size and configuration, such as one that was described as a huge viscus filling half the abdomen.[53] Meckel's diverticula are usually about the size of a small finger,[3] although they are said to vary in length from a small bud up to at least three feet.[9] They probably never attain the enormous size that is seen in some cases of intestinal duplication.

Meckel's diverticulum is a true diverticulum in that all layers of the intestine are present, whereas acquired diverticula are composed of mucous membrane supported by little or no smooth muscle.[33]

The diverticulum may be lined with normal ileal mucosa, as was found in 88 per cent of the cases of Shallow *et al.*,[45] although a significant number of them contain some heterotopic tissue such as pancreatic, gastric, duodenal or colonic mucosa. The frequency with which heterotopic tissue is found will depend upon the source of the material studied. For instance, in routine necropsy cases Schaetz[43] found gastric mucosa in the diverticulum in only 16 per cent, whereas in an analysis of clinical material, presumably symptomatic, Good and Fletcher[20] found gastric mucosa in the diverticulum in 88 per cent. These figures are in general agreement with those of other published reports.[27]

COMPLICATIONS

Meckel's diverticula acquire clinical importance only after a complication develops, which is said to occur in approximately 25 per cent of cases.[10] The four major clinical conditions associated with Meckel's diverticula are abdominal pain, intestinal bleeding, intestinal obstruction, and intestinal perforation, any of which may occur as the result of any of the following pathologic changes involving the diverticulum:

A. *Acute inflammation.*

B. *Peptic ulcer* (usually associated with heterotopic gastric mucosa).

C. *Foreign body in the diverticulum*, such as fish bone or chicken bone.[44,51]

D. *Neoplasm* (myoma, lipoma, carcinoid, neuroma, papilloma, carcinoma, sar-

coma, and heterotopic tissue such as pancreatic adenoma).

E. *Intussusception* (may be associated with a neoplasm in the diverticulum).[1,8,18,19,26,32,39]

F. *Knots of the diverticulum*.[50]

G. *Internal hernias* (the diverticulum forming a loop by either its tip being attached to another intraperitoneal structure or by a persistent fibrous band from the tip to the umbilicus).[46] This forms a loop through which other intestinal loops herniate.

H. *External hernias*, such as femoral or inguinal, containing a Meckel's diverticulum (Littre's hernia).[19]

I. *Volvulus of the intestine* (with the tip of the diverticulum fixed or attached to the umbilicus by a fibrous band and acting as the hub of a wheel).[19]

The most common clinical manifestation is probably bleeding which, in turn, is most commonly associated with peptic ulcer and heterotopic gastric mucosa in the diverticulum.[20,46]

ROENTGEN DIAGNOSIS

Reference has already been made to the rarity with which Meckel's diverticula have been identified roentgenologically. The most impressive record is that of Good and Fletcher who reported that of 17 cases operated on at the Mayo Clinic for a pathologic process associated with Meckel's diverticulum 11 had adequate roentgen examination of the small intestine. Of these 11 cases, the diverticulum was identified preoperatively in 4 and was suspected in a fifth case.[20] One of these cases was described in detail.

In our experience the diverticulum is more commonly demonstrated during the course of a barium meal study of the small bowel, although at times it may also be visualized when barium refluxes into the ileum during a barium enema.

The purpose of the barium meal examination is to visualize each individual loop of small intestine when distended by barium; and also when partially empty, in order to see its mucosal pattern. This involves the use of fluoroscopy and roentgenography, including compression, at intervals appropriate to the rate of progress of the opaque meal and the degree of distention of the small bowel which it produces. In some patients this requires observations every fifteen or twenty minutes during all or part of the examination. We have found it undesirable to make the intervals longer than one hour. While fluoroscopy is a necessary adjunct, major dependence must be placed upon the film study which should consist of large roentgenograms throughout the entire examination supplemented by smaller films of individual loops separated from each other by means of a compression device (which may be as simple as a folded towel). The roentgen study is continued until less than 10 per cent of the barium remains in the small intestine, since this may permit recognition of a retentive diverticulum which might otherwise be overlooked when obscured by superimposed intestinal shadows. If continuous filling of the ileal loops cannot be obtained, a small intestinal enema might be employed; but we have not found this necessary, so far.

When filled with barium, the diverticulum usually appears as a tube-like projection arising from the ileum. If the exact site of origin is not identified, the diverticulum may appear merely as a barium projection which is recognized as being unusual because, even on compression, it maintains a single lumen rather than the pattern of a knuckle of bowel in which the two limbs are superimposed. Sometimes, as has been stated, the diverticulum remains filled with barium after the rest of the small bowel is empty, which can be helpful in its identification. Ehrenpreis[16] has described the occasional orientation of the diverticulum wherein it points toward the umbilicus in all views, both lateral and anteroposterior, due to a persisting fibrous cord (vitelline duct remnant) connecting the diverticulum to the umbilicus. In 1934 Pfahler,[38] when describing the first known case of Meckel's diverticulum diagnosed

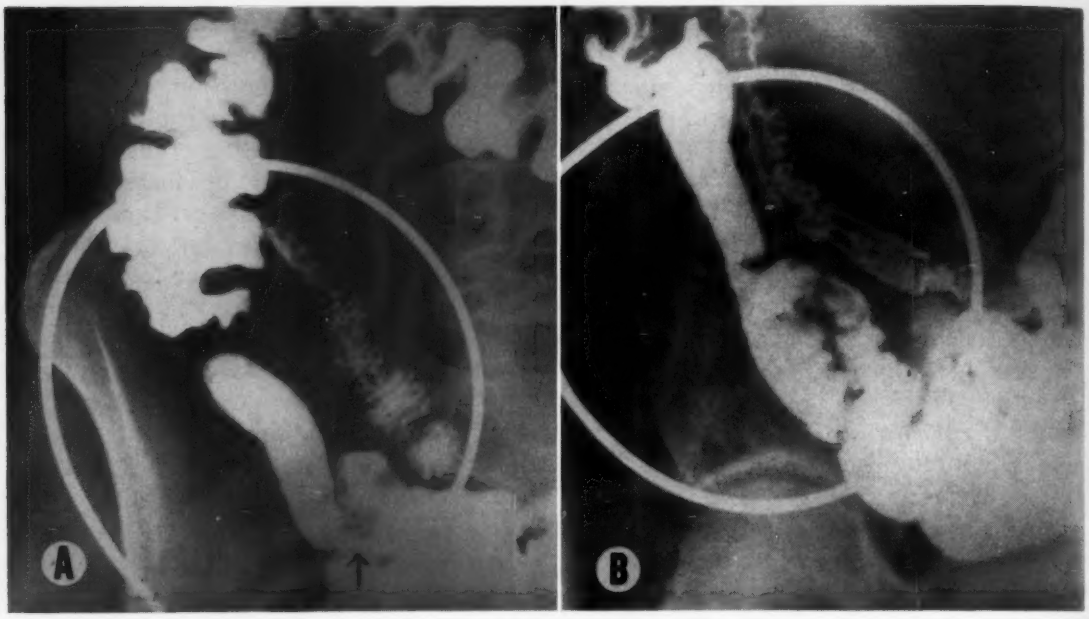

FIG. 2. Case I. (*A*) Barium enema study; compression film of the ileocecal region. The horizontal arrow indicates the barium-filled Meckel's diverticulum. The vertical arrow points to the neck of the diverticulum at its origin from the ileum. (*B*) Barium enema study; compression film, showing the neck of the diverticulum in better detail (arrow).

by roentgen examination, stressed the change in configuration of the diverticulum due to active peristalsis. Lewitan[33] has re-emphasized this, stating that the demonstration of peristaltic activity in the diverticulum indicates the presence of a muscular layer and therefore serves to differentiate the Meckel's type from the acquired type of intestinal diverticulum which does not have a significant muscular layer in its wall.

At times the identification of the diverticulum may be facilitated by the persistent trapping of gas in it, as occurred in 3 of our cases (Case I, II, and III), and on several occasions a gas-filled Meckel's diverticulum has been identified on a preliminary plain roentgenogram of the abdomen.[31,36] Bischoff and Stampfli[4] have reported 2 cases of roentgenographically demonstrated Meckel's diverticula each of which contained an opaque calculus, and in each case the calculus presented a "folded-ribbon-like" shadow within a gas bubble on the plain abdominal roentgenogram which they believed might be characteristic.

Recently, Kump *et al.*[29] have reported a case in which ectopic gastric mucosa in a Meckel's diverticulum was identified roentgenographically by noting the typical rugal pattern.

REPORT OF CASES

CASE I. M.M., a fifty-six year old white female, was studied at the Graduate Hospital because of recurrent attacks of abdominal pain and diarrhea. Roentgen examinations consisted of a small intestinal progress meal study performed on June 7, 1950, and a barium enema study performed on June 16, 1950; in both studies a Meckel's diverticulum was diagnosed. It measured approximately $\frac{3}{4}$ by $2\frac{3}{4}$ inches and arose from the distal ileum at least 18 inches and perhaps as much as 3 feet proximal to the ileocecal valve (Fig. 2, *A* and *B*). At operation a Meckel's diverticulum lined with normal mucosa was found 22 inches from the ileocecal valve and was resected.

CASE II. W.S., a forty-three year old white male, was admitted to the Graduate Hospital because of an attack of violent lower abdominal pain two years previously, and several episodes of melena during the three months preceding

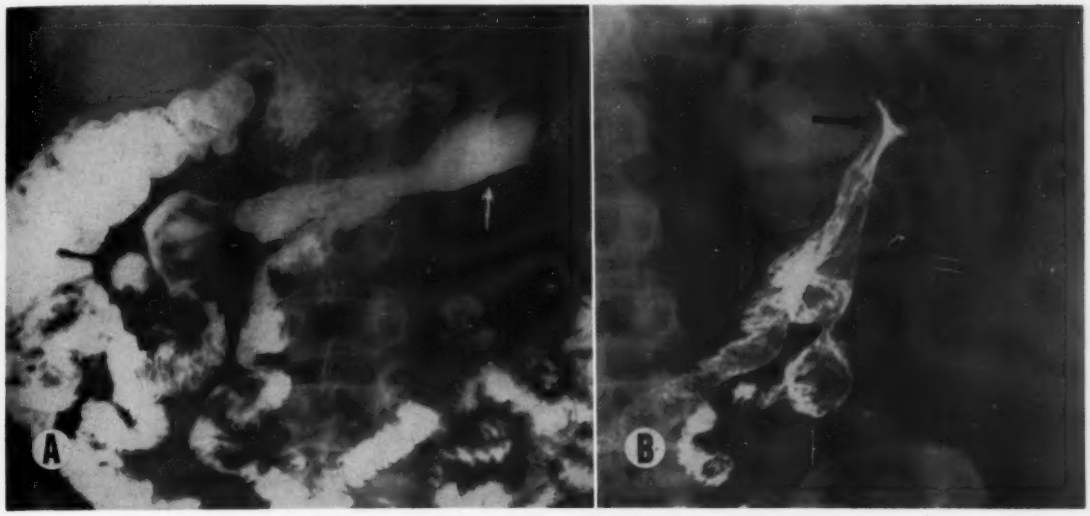

FIG. 3. Case II. (*A*) Progress meal study, two hour film. A large Meckel's diverticulum containing barium and air is seen lying transversely across the mid-abdomen at the level of the second lumbar vertebra (arrow). (*B*) Progress meal study, five days later, 5 hour film. Re-examination showing the Meckel's diverticulum, again containing barium and air, lying in the left mid-abdomen (arrow).

admission. Roentgen examination consisted of two small intestinal progress meal studies performed on February 21, 1955 and February 26, 1955, which revealed a barium-filled structure in the left upper abdomen which was reported preoperatively as "a large Meckel's diverticulum arising from the ileum approximately 24 inches proximal to the ileocecal junction" (Fig. 3, *A* and *B*). At operation a Meckel's diverticulum about 9 inches long lined with normal mucosa

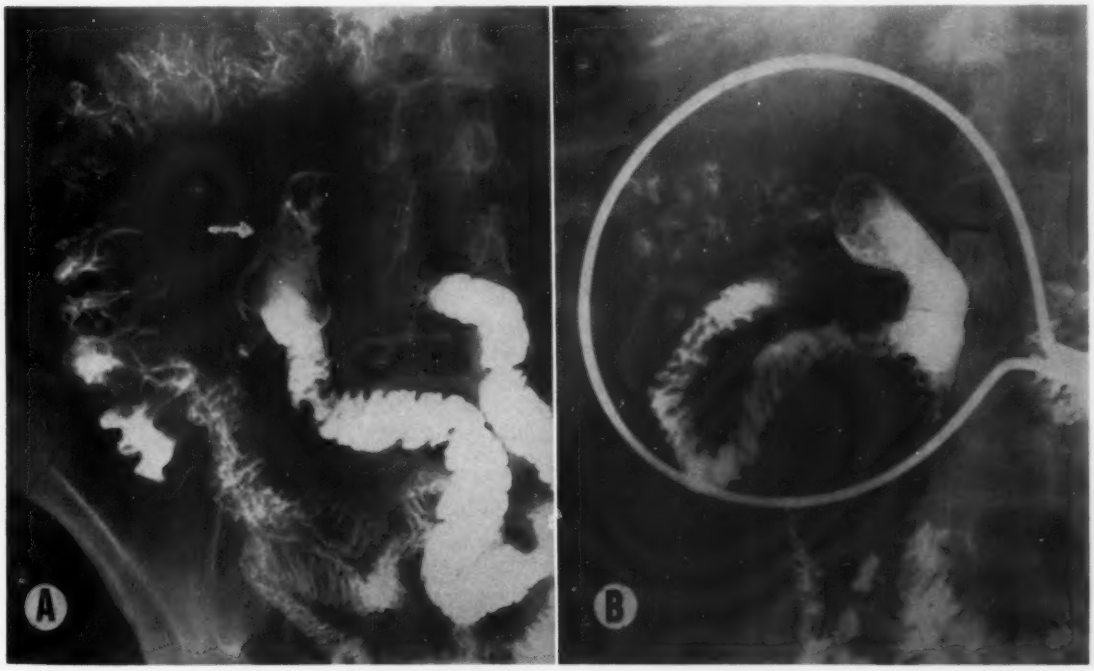

FIG. 4. Case III. (*A*) Barium enema study. A Meckel's diverticulum containing a large amount of air and a small amount of barium, is seen arising from the distal ileum (arrow). (*B*) Progress meal study, three days later, one and one-half hour compression film. A Meckel's diverticulum containing a moderate amount of air and barium, is again demonstrated (arrow).

FIG. 5. Case IV. Progress meal study, six and one quarter hour compression film. Arrow indicates the barium-filled Meckel's diverticulum arising from the distal ileum.

was found 18 inches from the ileocecal junction and was resected.

CASE III. I.Y., a sixty-seven year old female, was seen at the Graduate Hospital because of recurrent attacks of right lower quadrant pain. There was no history of melena but she had a moderate anemia and her stools were positive 4 plus for occult blood. Roentgen examination included a barium enema study performed on February 7, 1955, and a progress meal study of the small intestine performed on February 1, 1955. In both studies a diverticulum measuring 2 to 3 inches in length and approximately 10 inch at its greatest diameter was demonstrated arising from the distal ileum about 2 feet proximal to the ileocecal junction. This was reported preoperatively as a Meckel's diverticulum. The diverticulum usually contained air as well as barium on repeated exposures during the examination (Fig. 4, *A* and *B*). At operation a Meckel's diverticulum lined with normal mucosa was found about 3 feet proximal to the ileocecal junction and was resected.

CASE IV. F.M., a fifty-three year old white male, was studied at the Graduate Hospital because of unexplained anemia of a known duration of several months. There was no definite history of melena. Roentgen examination included 2 small intestinal progress meal studies performed on August 12, 1955 and September 12, 1955, and in both examinations a small projection of barium about 1 inch in length was noted arising from one of the mid or distal ileal loops which was diagnosed preoperatively as Meckel's diverticulum (Fig. 5). At operation a Meckel's diverticulum measuring 1 inch in length and $\frac{1}{2}$ inch in diameter was found arising from the ileum about 5 feet proximal to the ileocecal junction and was resected. Microscopic study revealed gastric mucosa in the diverticulum.

CASE V. M.P., a thirty-two year old white male, was investigated at the Graduate Hospital because of an episode of melena occurring

FIG. 6. Case V. Progress meal study, four hour compression film. The Meckel's diverticulum is demonstrated arising from the ileum approximately 4 inches proximal to the ileocecal junction.

several months previously. Roentgen examination included 4 small intestinal progress meal studies, only one of which, performed on February 1, 1955, revealed a small projection measuring approximately 1 inch in length and ½ inch in diameter arising from the distal ileum about 4 inches proximal to the ileocecal junction. This was interpreted as Meckel's diverticulum (Fig. 6). Operation has not yet been performed in this case.

SUMMARY

In spite of the rather frequent finding of Meckel's diverticulum at autopsy and at operation, the preoperative roentgen diagnosis is rarely made. We believe that this diagnosis can be made more commonly if barium progress meal examinations of the small intestine are performed with care and the diagnostic possibility kept in mind.

To the 33 cases reported in detail in the English literature, we now add 4 additional cases in which the roentgen diagnosis was made preoperatively. A fifth case diagnosed roentgenologically has not yet been verified. It is interesting to note that all of our verified cases occurrred in adults of middle age.

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VOL. 79, NO. 5

ENLARGEMENT OF THE ILEOCECAL VALVE

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ENLARGEMENT of the ileocecal valve is infrequently recognized. If an enlarged valve is occasionally noted by the roentgenologist, it is generally considered to be of no importance as an abnormality primarily associated with signs or symptoms of intra-abdominal disease. This lack of realization of the importance of the ileocecal valve in the production of abdominal distress has led the author to a critical and careful examination and evaluation of the ileocecal area and has resulted in the collection of a number of documented cases which confirm the association of observable abnormalities with symptoms.

The ileocecal region should always be examined as thoroughly as the gastroduodenal region. Indifference to the necessity of complete examination results in the frequent failure to discover abnormalities in this area. It has been stressed that the ileocecal region should be studied after oral administration of barium as well as after retrograde filling[4] of the colon and terminal ileum. However, the most important procedure is fluoroscopy after evacuation of the barium enema. Any demonstrated abnormality following ingestion of the contrast medium provides fairly certain assurance that it is not produced by cathartic or other irritating medication. Examination after evacuation of opaque enema is done under the most nearly normal physiologic or dynamic conditions and therefore provides the most critical study.

The anatomy and physiology[13] of the ileocecal valve have been studied for many years with diverse and changing opinions as to what constitutes normal and abnormal. The normal valve is generally formed by two folds, one above and one below a slit-shaped orifice, of mucosa, submucosa, and circular muscle. These folds protrude into the cecum for a distance of several millimeters. Several investigators[10,16] have indicated normal limits to the size of these folds. The orifice is usually seen as a thin slit but may be seen to vary greatly in diameter under fluoroscopic examination. There are many anatomic variations of configuration which may be one cause for the difficulty in distinguishing the abnormal from the normal valve. Abnormalities of the ileocecal valve have been reported by previous investigators[2,5,7,8,9,11,12,14,15,17] in patients who have had symptoms of intra-abdominal disease. However, there is sharp disagreement as to whether or not enlargement of the ileocecal valve is of any clinical significance. One investigator[1] states that insertion of an object in the ileocecal orifice produces no appreciable discomfort. However, digital distention* of the ileocecal orifice will produce severe periumbilical pain, nausea and vomiting, all relieved when the finger is removed. Incidentally, the same symptoms are produced by similar distention of the appendix.

Recently, the ileocecal valve syndrome[16] has been described in a group of patients who have had abdominal symptoms with roentgenologic findings of an enlarged ileocecal valve. The primary symptoms are bloating, right sided abdominal pain and tenderness at the site of the ileocecal valve. None of these patients was operated on. There is no reported group of patients in which the syndrome has been recognized, in which there have been localized roentgenographic and fluoroscopic findings, and in which there has been planned definitive surgery with follow up indicating relief of symptoms.

Apparently the location of the pain in the right abdomen has led to a more critical study of the area of the intestinal tract so that the reported cases are those which

* Personal experience in an instance of prolapsed cecum through a cecostomy.

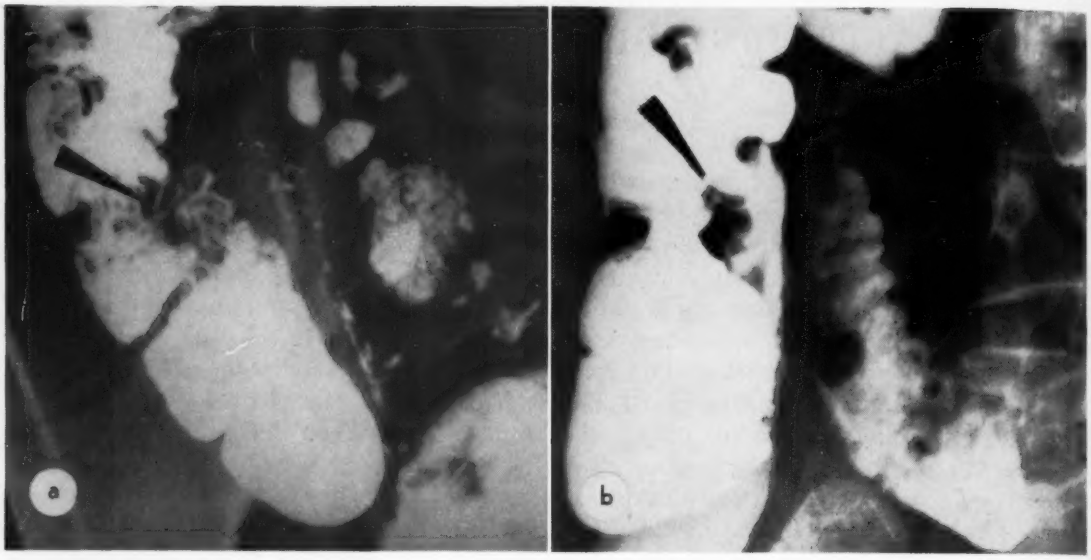

Fig. 1. (*a*) Enlarged ileocecal valve visible five hours after oral barium mixture administration. (*b*) The same after evacuation of barium enema. Note mild dilatation of ileum.

have had right-sided pain. Reproduction of the referred pain by pressure over the ileocecal junction, located fluoroscopically, is an important diagnostic point. Occasionally there is no local tenderness, only referred pain produced by manual pressure through the abdominal wall. In the author's experience, pain from any disease in the ileocecal region is usually periumbilical, such as is typical in the early stages of appendicitis. The pain is cramp-like when there is some degree of obstruction. Frequently there is no more than a feeling of abdominal fullness, sometimes interpreted by the patient as constipation. The mild abdominal fullness may predispose the

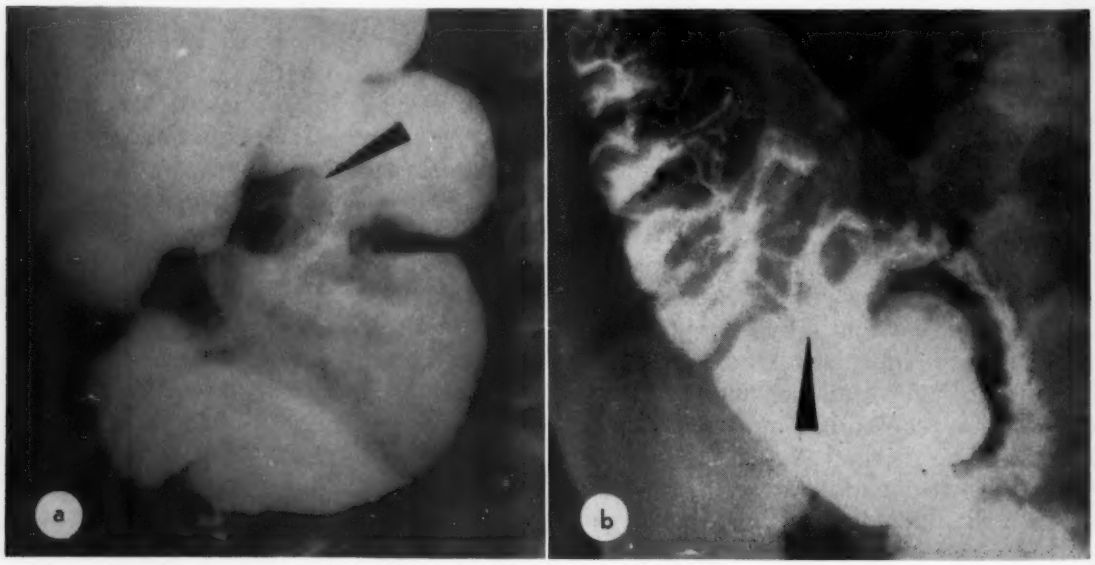

Fig. 2. (*a*) A large ileocecal valve indents the filled cecum laterally. Note very narrow lumen. (*b*) After evacuation the valve is more clearly visible. The cecum has rotated to a lateral position.

patient to peptic regurgitation in the esophagus and the resulting symptoms of peptic esophagitis.

Though the primary and most distinctive symptoms of the ileocecal valve syndrome are bloating, pain and tenderness in the right abdomen, any or all of these symptoms may be produced by several other entities including appendicitis, nonsclerosing ileitis, regional ileitis, cecitis, peritoneal adhesions, cholecystitis, and diseases of the right genitourinary tract in which there may be some degree of reflex ileus. Furthermore, ileocecal valve enlargement may produce pain referred to the right upper abdomen, right flank, left lower abdomen, left upper abdomen or even to the right inguinal region. This varied referral pattern can be verified by careful palpatory examination at fluoroscopy.

Because of the variability of the symptoms, many of these patients are subjected initially to examination of the gallbladder or urinary tract. For the same reason a thoroughly meticulous study must be made to exclude other disease and to be certain that the local ileocecal enlargement is causing the presenting symptoms. One must not be misled by the fact that ileocecal tenderness may occur in many patients with mild degrees of ileitis, nonspecific enteritis or colitis found incidentally at fluoroscopy in patients having definite serious trouble elsewhere in the abdomen. Symptomatic abnormalities of the ileocecal region are relatively common, although of a type which can be relieved medically, or the symptoms may be of such a mild degree as to require only the identification of the cause to reassure the patient. Surgical intervention is rarely necessary or warranted. If the symptoms are of sufficient degree and if relief can be obtained in no other manner, surgery is to be recommended. Up to the present time, nothing less than ileocecal resection and re-anastomosis has been effective.

Enlargement of the ileocecal valve is a descriptive term for the roentgenographically abnormal appearance of the ileocecal junction. Reference is made to the lips of the valve rather than the orifice. However, it would seem more important to determine or demonstrate the size of the lumen, a difficult feat. An entirely normal valve may be seen as a narrow slit, the

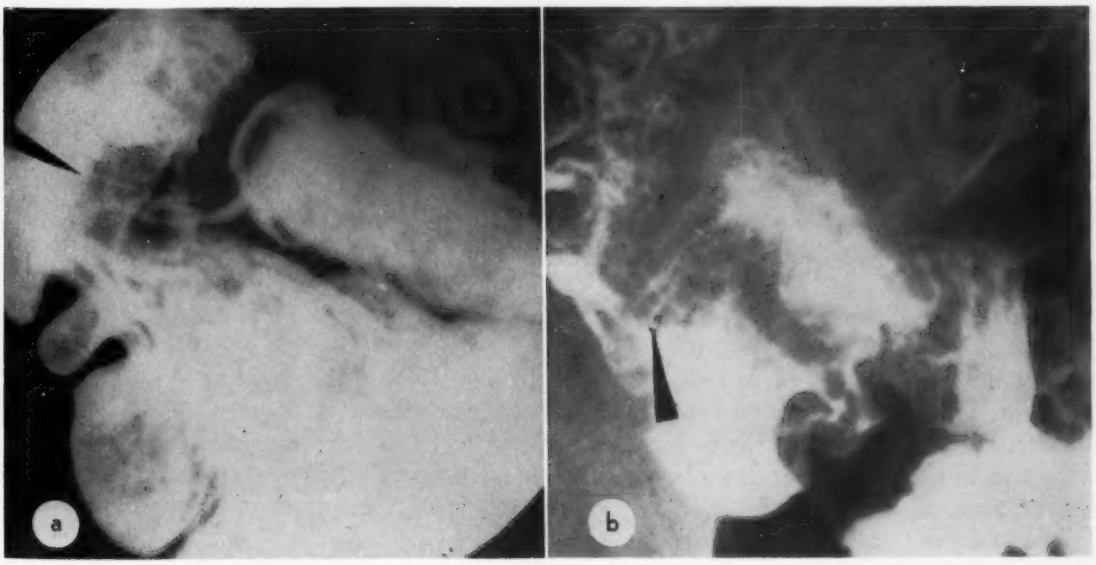

Fig. 3. (*a*) Compression fluorogram of enlarged valve projecting into the cecum of the colon filled by barium enema. (*b*) After evacuation examination shows greater indentation of cecum with more than average fullness of terminal ileum.

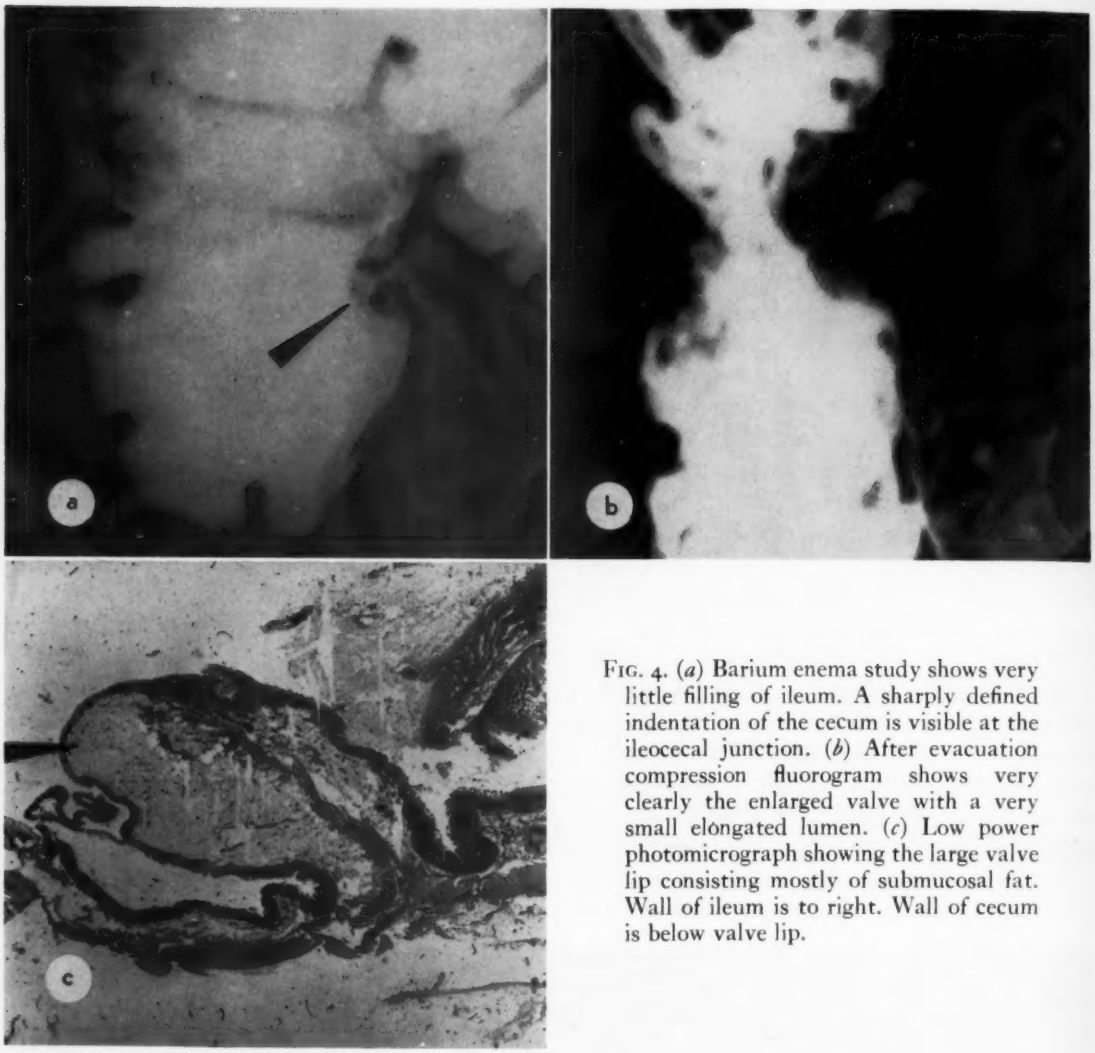

FIG. 4. (*a*) Barium enema study shows very little filling of ileum. A sharply defined indentation of the cecum is visible at the ileocecal junction. (*b*) After evacuation compression fluorogram shows very clearly the enlarged valve with a very small elongated lumen. (*c*) Low power photomicrograph showing the large valve lip consisting mostly of submucosal fat. Wall of ileum is to right. Wall of cecum is below valve lip.

greatest width of which can rarely be visualized in any feasible projection. An abnormal valve may show a tiny round orifice indistinguishable roentgenologically from the normal slit. Therefore, the thickening of the valve lips at least serves to attract the attention of the radiologist. The enlargement of the valve should then be considered significant only in the presence of associated symptoms and localizing signs and in the absence of any other cause for the abdominal distress.[6]

The causes[16] of enlargement include edema, submucosal fat accumulation, herniation of ileal mucosa, tumor and inflammatory lesions in which the valve may be involved. Preoperative determination of the cause of the enlargement is difficult. Fat infiltration produces a sharp, smooth outline of the enlarged valve which does not vary in size on comparative examinations and is not associated with alteration of the mucosal pattern in the adjacent terminal ileum. Edematous enlargement produces a flabby tumescence with less constriction of the ileocecal orifice and with some associated alteration in the mucosal pattern of the adjacent terminal ileum.

REPORT OF CASES

CASE 1 (Fig. 1). V.M., a thirty-two year old female, complained of pressure in the rectum

and aching in the right lower abdomen for a period of three to four years. The complaints seemed quite vague. Bilateral salpingectomy and appendectomy were done in 1937. Numerous roentgenologic examinations had been made. At operation the terminal ileum was dilated and invaginated on itself with intrusion into the cecum. This condition was relieved by sharp dissection. The cecum was then resected and ileocolostomy done. The histologic examination showed only moderate submucosal inflammation and edema of the wall of the cecum. The gross architecture of the ileocecal juncture had been destroyed by the surgery. There has been no recurrence of abdominal trouble since surgery five years ago.

Case II (Fig. 2). R.W., a thirty year old male, complained of right lower abdominal pain with nausea and occasional vomiting for

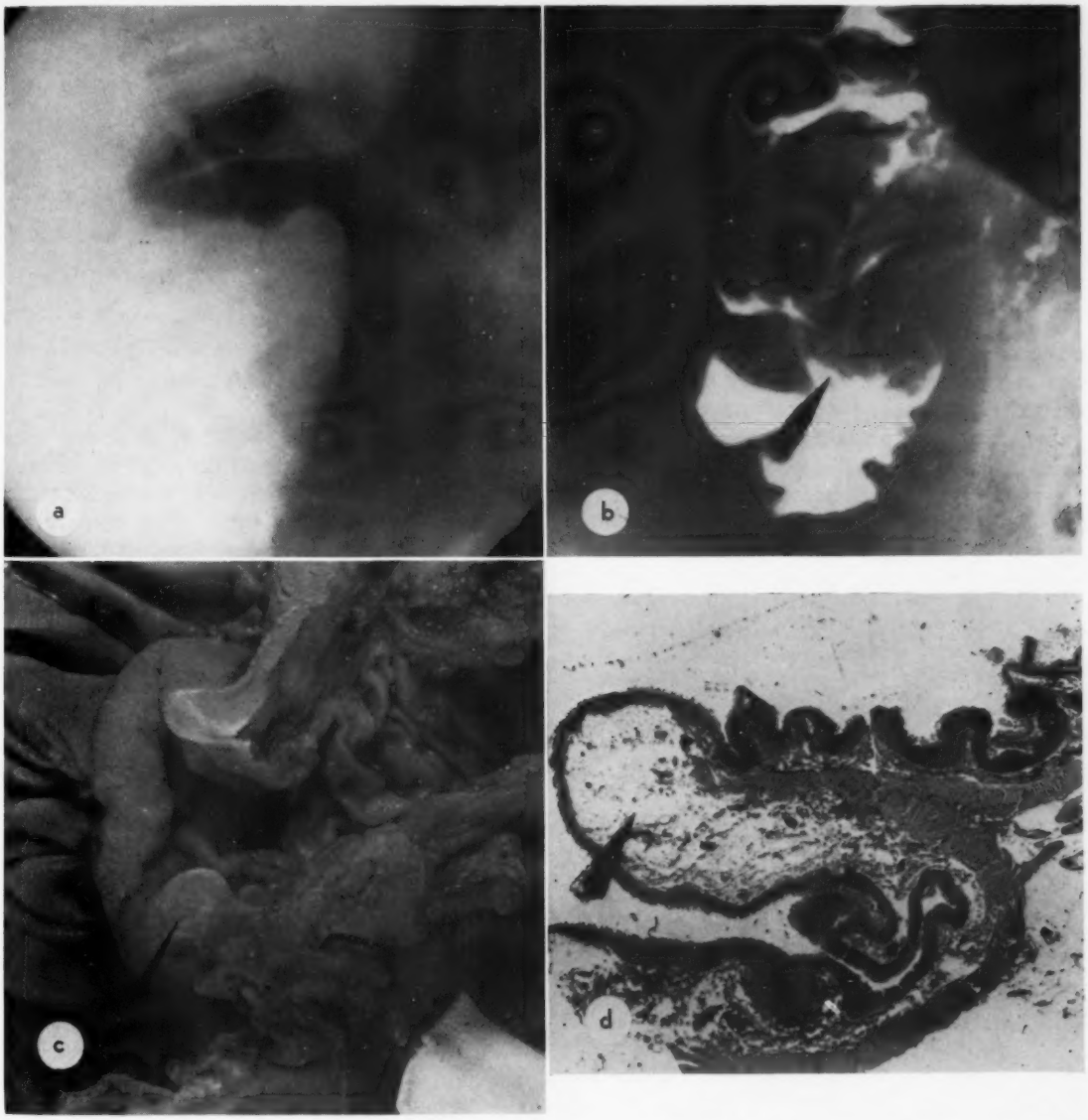

Fig. 5. (*a*) The cecum is distended by barium enema. Note large valve lips with very narrow lumen. (*b*) After evacuation the marked enlargement is well demonstrated. Note some coarsening of the mucosal folds in the terminal ileum. (*c*) Fixed specimen. The lumen appears widely patent because of the process of fixation. (*d*) Low power photomicrograph showing the large valve lip consisting mostly of submucosal fat. Wall of ileum is to right. Wall of cecum is below valve lip.

FIG. 6. (*a*) Similar to Figure 5 with deep indentation of cecum by thick lips of valve. (*b*) Fresh surgical specimen showing pouting valve lips.

eight weeks. His appendix had been removed eleven years before. At operation a doughnut shaped mass at the ileocecal junction was palpable. An opening made in the cecum showed the "intussusception." Ileocecal resection was done but revision was necessary within twenty-four hours because of bleeding at the site of the anastomosis. There has been no recurrence of symptoms since the operation five years ago. The surgical specimen was not described histologically, having been inadvertently mislaid.

CASE III (Fig. 3). E.V., a thirty-seven year old female, had been to six different physicians for her complaints. There was soreness in the abdomen, particularly in the right costovertebral angle and some in the left lower quadrant. Morning nausea was present for six to eight

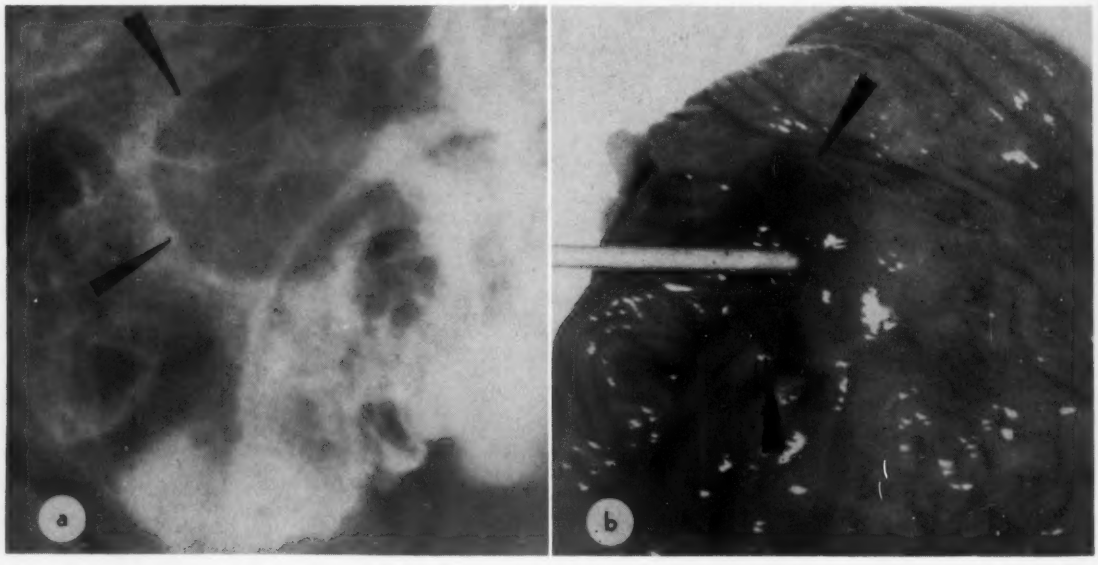

FIG. 7. (*a*) Annular enlargement of the valve is best seen on compression fluorogram after evacuation of barium enema. (*b*) Fresh surgical specimen with applicator in very small ileocecal lumen. Valve quite prominent. Primarily chronic inflammation.

months. Previous operations included left oophorectomy and salpingectomy, hysterectomy and right salpingo-oophorectomy and appendectomy. Present diagnostic examinations included barium enema, upper gastrointestinal study, retrograde urography, and cystoscopy. Ileocecal resection relieved her of her symptoms with no recurrence in the subsequent four and one-half years. The examination of the resected segment of intestine showed submucosal edema of the ileocecal valve and mild serosal inflammation.

Case IV (Fig. 4). V.W., a forty-seven year old female, had abdominal cramps for eighteen months. The cramps were severe enough to cause perspiration and vomiting. These episodes were recurring more frequently. Radiation therapy had been given for cancer of the uterine cervix about eighteen months previously and it was thought that her symptoms might be due to radiation damage to the intestine. However, gastrointestinal examination demonstrated changes at the ileocecal juncture which was resected. She has been free of abdominal pain since the operation four years ago. The ileum extended into the cecum about 2 cm. Microscopic examination showed submucosal fat infiltration at the ileocecal valve with partial obstruction of the valve and hypertrophy of the terminal ileum.

Case V (Fig. 5). P.C., a forty year old female, had symptoms of partial bowel obstruction for five or six years. There was recurrent right lower abdominal pain and distention. Roentgenologic examination demonstrated changes at the ileocecal juncture. Ileocecal resection relieved all her symptoms and she has had no further complaint. However, only about eighteen months have elapsed since surgery. Microscopic examination showed marked fat infiltration of the submucosa in the thickened valve lips.

Case VI (Fig. 6). M.B., a forty-five year old female, was hospitalized for observation and medical management because of midabdominal pain and inability to eat solid foods. Roentgenologic examination localized the disorder at the ileocecal junction and showed prominence of the valve. She was tried on medical management for four months without relief. Finally, she was readmitted to the hospital and an ileocecal resection was done. The pathologist reported a chronic moderate inflammation of the ileum and ileal part of the ileocecal valve. The

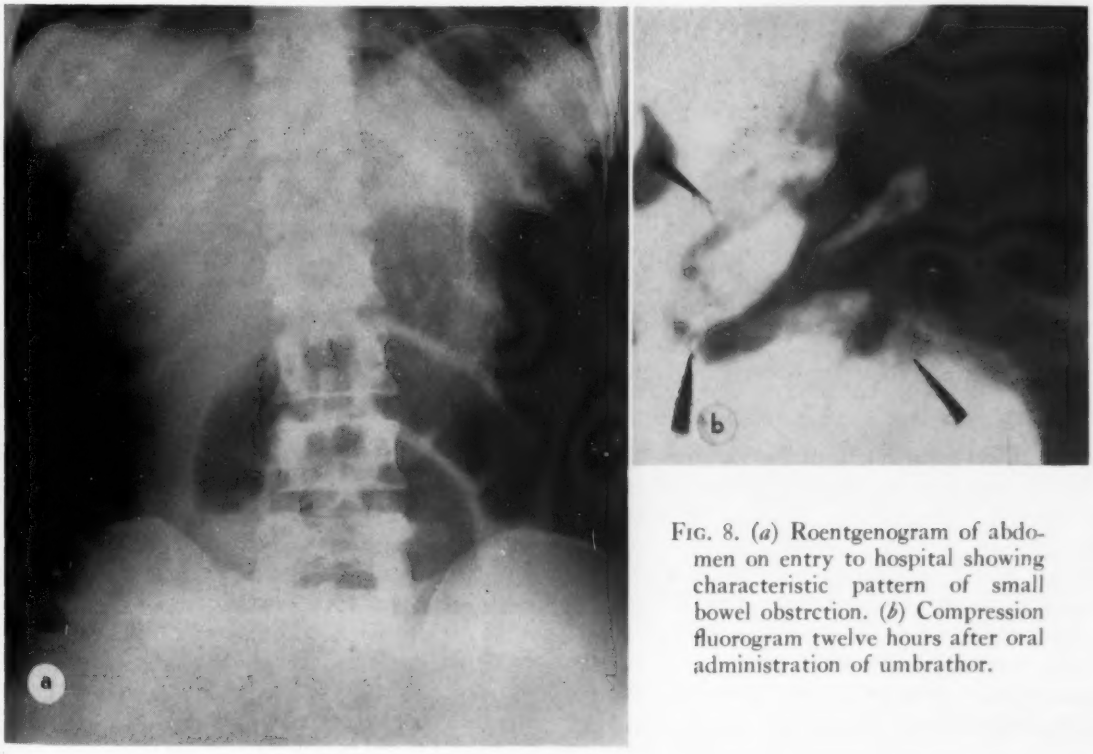

Fig. 8. (*a*) Roentgenogram of abdomen on entry to hospital showing characteristic pattern of small bowel obstrction. (*b*) Compression fluorogram twelve hours after oral administration of umbrathor.

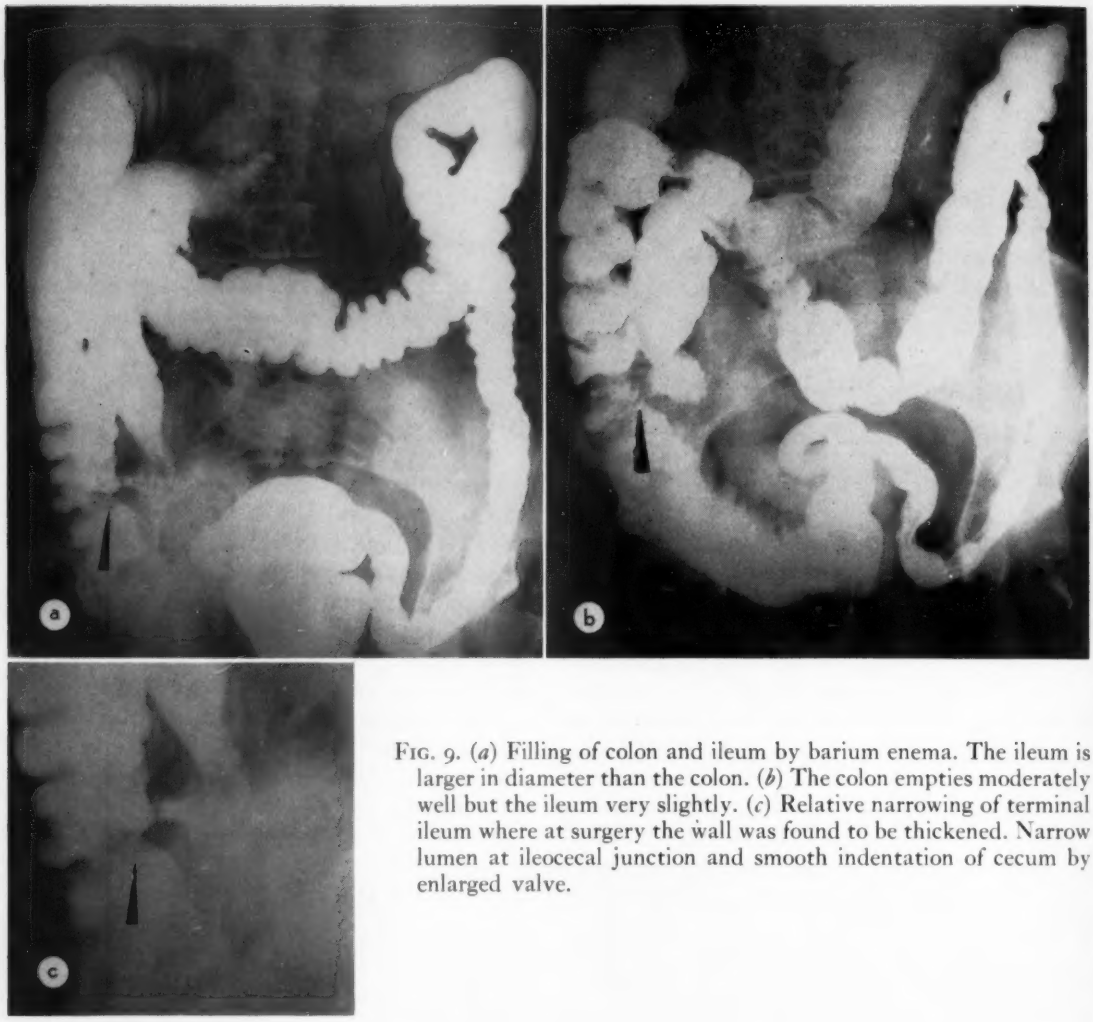

FIG. 9. (*a*) Filling of colon and ileum by barium enema. The ileum is larger in diameter than the colon. (*b*) The colon empties moderately well but the ileum very slightly. (*c*) Relative narrowing of terminal ileum where at surgery the wall was found to be thickened. Narrow lumen at ileocecal junction and smooth indentation of cecum by enlarged valve.

pathologic changes were not of a specific type and bore no resemblance to fully developed regional ileitis, but the possibility of an early stage of the disease could not, by any means, be excluded. There has been no recurrence of symptoms since the operation eighteen months ago.

CASE VII (Fig. 7). D.R., a twenty year old female, was referred for gallbladder and gastrointestinal examinations because of recurrent distress in the right lower abdomen for two years. There was occasional radiating pain to the right back and even down into the right leg anteriorly. At first, appendicitis and later urinary tract infection were suspected. She had lost twenty pounds in the past five months. Psychiatric consultation was obtained. After dietary and medical management had failed to relieve her symptoms, ileocecal resection was done with relief of symptoms and no recurrence in the eighteen months since. The pathologist reported an enlargement of the ileocolic valve and partial fibrosis of the appendix. The valve lips measured 2.2 by 1.5 cm. and projected into the cecum 0.9 cm.

CASE VIII (Fig. 8). A.A., a thirty-six year old female, was admitted to the hospital on a presumptive diagnosis of bowel obstruction. She had crampy abdominal pains, especially in the right lower quadrant, usually about three hours after meals. She felt fairly well on a diet of soft food. Examination several months before had indicated that there was partial obstruction at the ileocecal juncture due to an enlarged valve.

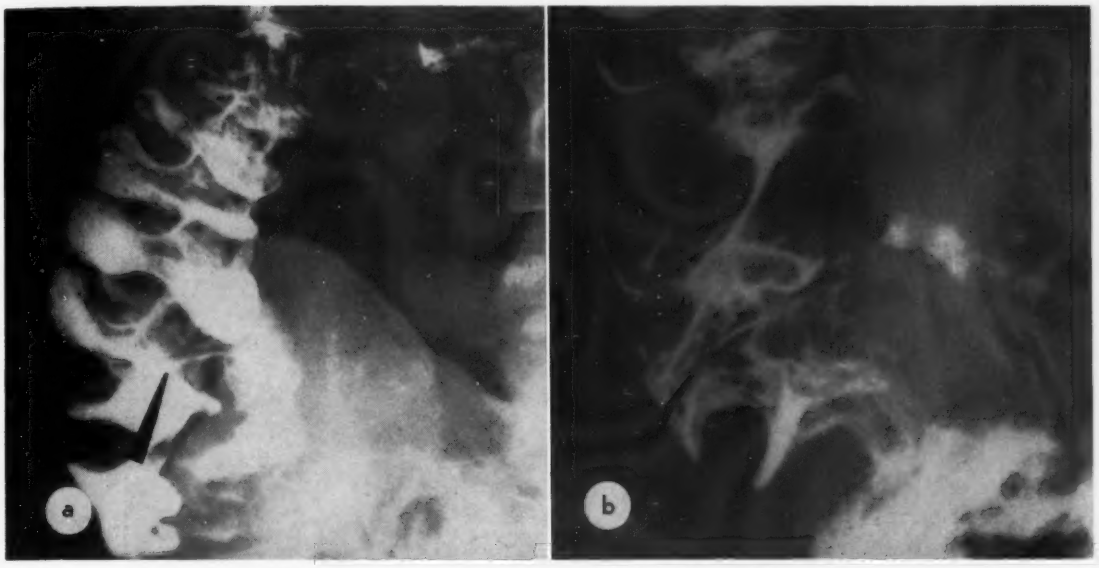

Fig. 10. (*a*) Enlarged valve with narrow lumen. Note dilatation of terminal ileum. (*b*) Recurrence of "deformity" one month after incomplete surgery. There is postoperative deformity of mucosal pattern in the terminal ileum.

The surgeon was prevailed upon to re-examine the patient with a radiologist to aid him in locating the lesion. Subsequent operation revealed a palpable two inch mass in the cecum. The mass was made to disappear by sharp dissection and release of the "intussusception." A four inch segment was thus unrolled. The patient had recurrent symptoms of obstruction four days later and was reoperated on. The "intussusception" had recurred. The bowel was divided at the ileocecal junction and reimplanted. The patient has been well since the operation seven years ago, except for one episode of difficulty due to adhesions at the peritoneal surface of the laparotomy scar. This was the first of the group of patients operated upon.

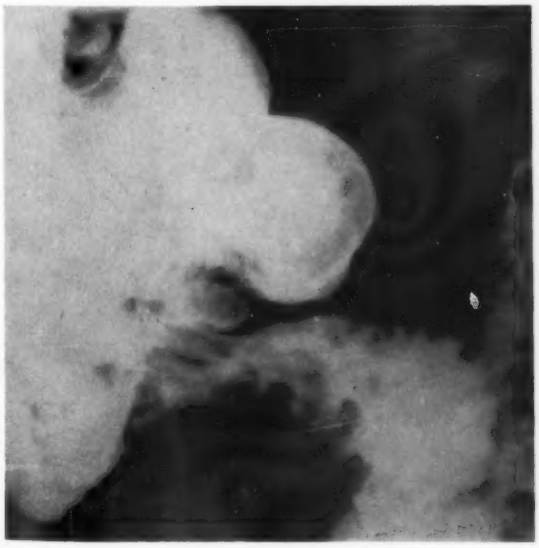

Fig. 11. Ileocecal intussusception at fluoroscopy five hours after the ingestion of a barium meal. The tip of the appendix is just visible. Mucosal folds in terminal ileum are coarse and irregular (nonsclerosing ileitis).

Case ix (Fig. 9). P.C., a sixty-five year old female, had been examined locally about twelve years earlier because of postprandial abdominal pain and distention. No cause was demonstrated. About six years ago she was examined in one of the large eastern medical centers and she says she was told she had a "nervous stomach." Her symptoms became more severe and her last examination showed partial obstruction at the ileocecal juncture. Local resection was done and prostigmin utilized to reduce the small bowel dilatation. However, ileus recurred with cessation of prostigmin. Gradual withdrawal resulted in good recovery for about a year when she was operated upon again for partial bowel obstruction due to adhesions from the previous surgery.

Case x (Fig. 10). V.S., a thirty year old female, complained of recurring right lower abdominal pain for eight years. There was no

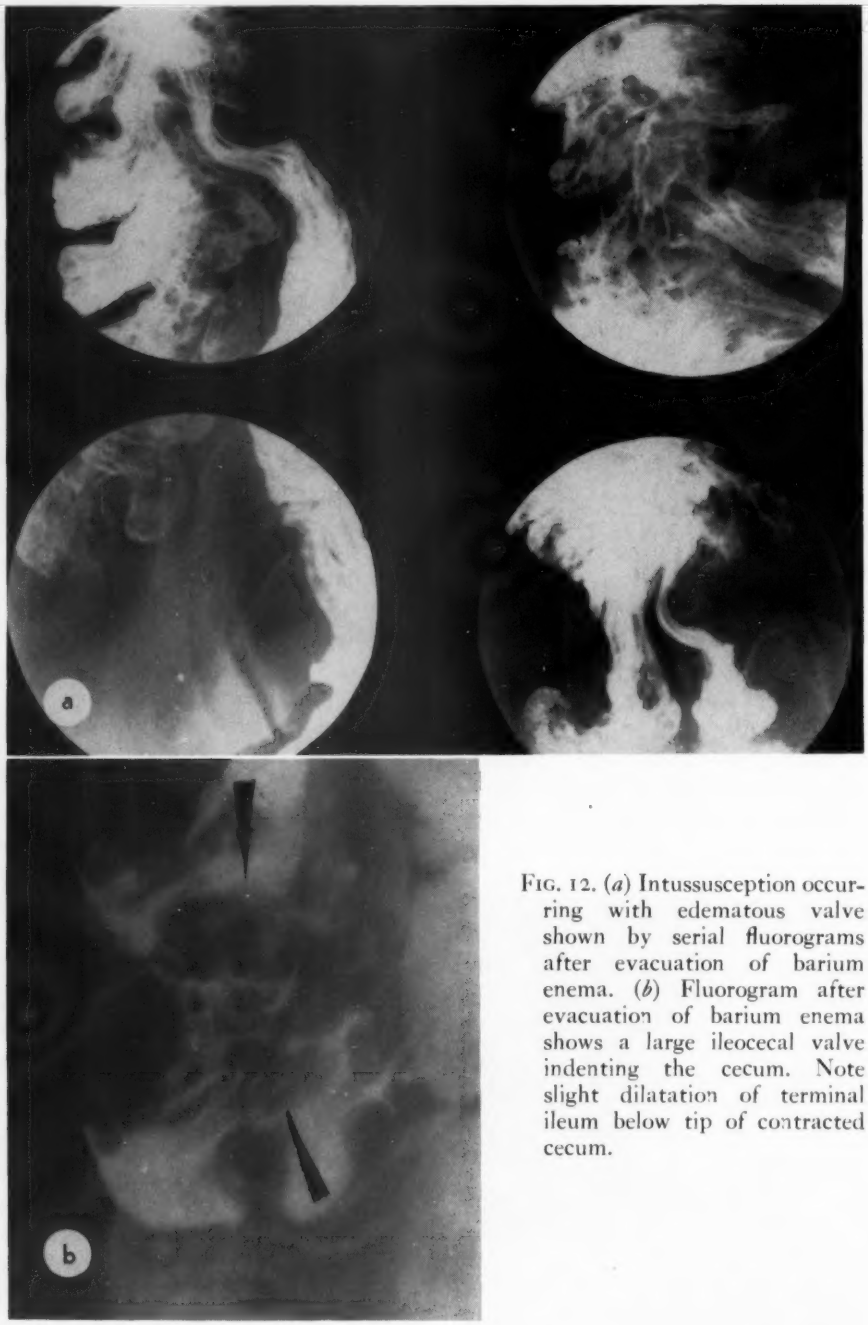

Fig. 12. (*a*) Intussusception occurring with edematous valve shown by serial fluorograms after evacuation of barium enema. (*b*) Fluorogram after evacuation of barium enema shows a large ileocecal valve indenting the cecum. Note slight dilatation of terminal ileum below tip of contracted cecum.

bloating. There was occasional diarrhea. Pains lasted from fifteen minutes to several hours. Her appendix had been removed three years before and right oophorectomy had been performed two years before for the same pain which persistently recurred. The "intussusception" found at time of laparotomy was relieved by sharp dissection by "unrolling" several centimeters of ileum. Her old pain recurred eight days after surgery.

The possibility of intermittent relenting intussusception was considered by Rigler and Lasser[16] but it was their opinion that it is not observed in the presence of ileocecal valve enlargement. Five such in-

stances, 1 in a child and 4 in adults, have recently been seen and demonstrated fluoroscopically. The following is a brief résumé of the history of these cases:

Case xi (Fig. 11). P.P., a six year old female, was hospitalized because of five or six attacks of nausea and vomiting in the previous week. She became free of symptoms following a short course of antibiotics.

Case xii (Fig. 12). P.L., a thirty year old female, had recurring attacks of right lower quadrant pain. The appendix had already been removed. Intussusception occurred during fluoroscopy and was accompanied by abdominal crampy pains, not clearly localized.

Case xiii (Fig. 13). G.S., a thirty-three year old male, had recurring midabdominal pain, sometimes following meals, for two weeks. His appendix had been removed.

Case xiv (Fig. 14). L.F., a twenty-two year old female, was referred because of a palpable mass in the right abdomen. The request was made to differentiate this from possible ptotic kidney. The intussusception was reduced by barium enema but recurred once later. She was admitted to the hospital and the intussusception again reduced by barium enema with no further recurrence.

Case xv (Fig. 15). V.E., a thirty-six year old female, was referred for gastrointestinal examination because of recurrent abdominal cramps for several years. Intussusception occurred while the barium enema was being administered and was accompanied by crampy pain in the midabdomen.

COMMENT

Classification of microscopic findings (Table 1) brings out the fact that there is seldom a single distinct cause of enlargement of the ileocecal valve. Two of the specimens showed fat infiltration only. In most instances there was a combination of inflammation, edema, and fat infiltration of variable proportions. This combination suggests that the fat infiltration may be the end result of a chronic inflammatory reaction. The 3 patients (Case iv, v and ix) with the marked fat infiltration found at

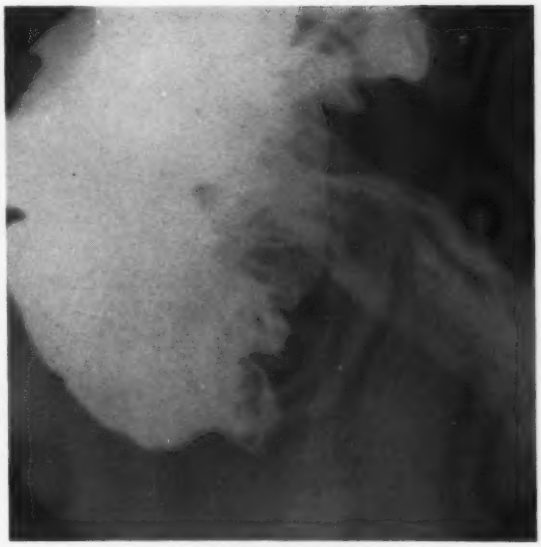

Fig. 13. Ileocecal intussusception seen at fluoroscopy after evacuation of barium enema.

microscopic examination gave a history of symptoms of longest duration.

In all of our operated cases, and in many unoperated cases treated medically for ileocecal disease, the roentgenologic examination was an extremely important factor in differential diagnosis and in deciding whether or not to use surgery. In 2 instances the radiologist recognized the symptom complex and the examination was done as a matter of exclusion and added proof of cause. In several instances the surgeon recognized the symptom complex after previous experience and requested consultation and examination also only for confirmation of his clinical impression.

Two of our patients had numerous operations for persistent or recurrent right abdominal pain. These operations included appendectomy, salpingectomy, oophorectomy, uterine suspension, nephropexy, lysis of adhesions and ureteral dilatation. This is a rather impressive list of unsuccessful procedures. Two of our patients (Case viii and x) finally had inadequate plastic procedures in the region of the ileocecal juncture with only temporary relief, one for four days and one for about one month. One of these 2 patients was re-

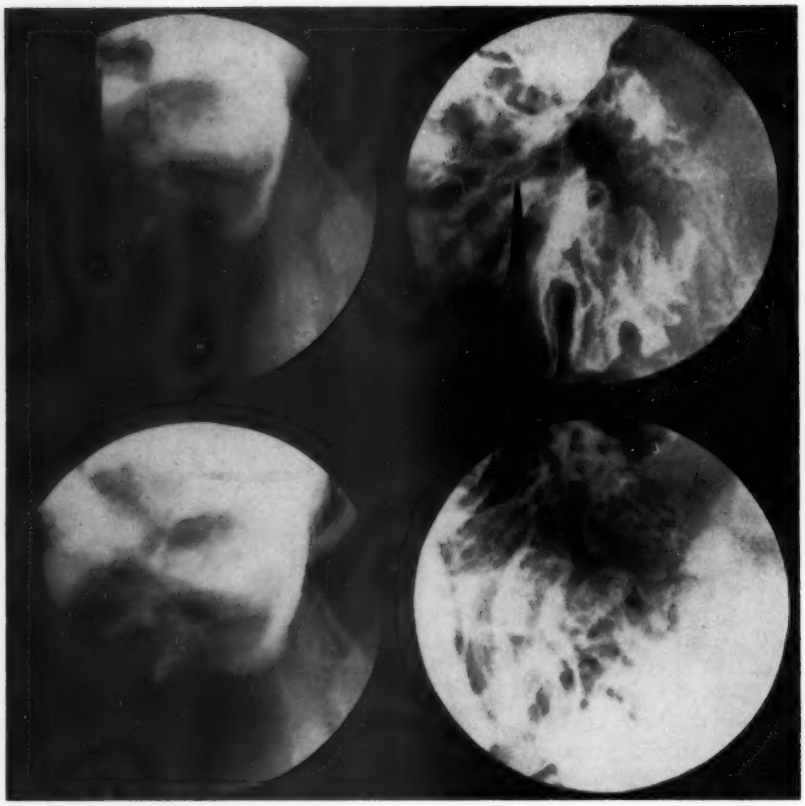

FIG. 14. Ileocecal intussusception before and after reduction showing edematous ileocecal valve and coarse irregular mucosal folds in the terminal ileum.

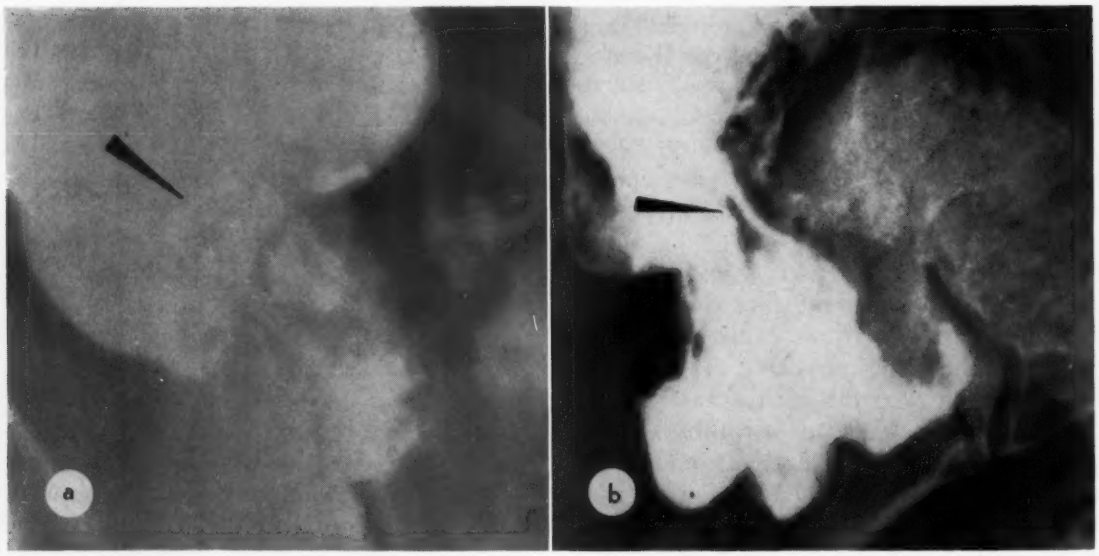

FIG. 15. (*a*) Transient ileocecal intussusception seen at fluoroscopy while filling the colon. (*b*) The edematous valve is demonstrated after evacuation of the barium enema. Again, note the dilatation of the ileum and the narrowing at the junction.

Table I

CLASSIFICATION OF CAUSES OF ENLARGEMENT OF ILEOCECAL VALVE

Case No.	Histology			
	Inflammation	Edema	Fat Infiltration	Principal Lesion
I. V.M. (45953)	+++	+	+	Hyperplastic lymphoid tissue in submucosa
II. R.W. (46329)	Specimen inadvertently lost with only gross description in operative notes			
III. E.V. (49295)	+	++	9	Submucosal edema and serosal inflammation
IV. V.W. (55938)	+	o	+++	Submucosal fat infiltration
V. P.C. (70393)	+	o	+++	Submucosal fat infiltration
VI. M.B. (69092)	++	+	+	Mixed lesion without marked changes. Lymphoid hyperplasia relatively outstanding
VII. D.R. (69677)	+++	+	o	Chronic inflammation and lymphoid hyperplasia in mucosa and submucosa
VIII. A.A. (33573)	+++	+++	o	Chronic inflammation, adventitial or serosal
IX. P.C. (64880)	++	+++	+	Edema and chronic inflammation with lymphoid hyperplasia in mucosa and submucosa
X. V.S.	No specimen. See text.			

lieved of all symptoms after ileocecal resection.

SUMMARY

Enlargement of the ileocecal valve due to edema, submucosal fat accumulation, prolapse of ileal mucosa or inflammation is seldom considered as a symptom producing entity. The symptoms generally consist of bloating, right sided abdominal pain and tenderness at the site of the ileocecal valve. This combination has been defined as the ileocecal valve syndrome. A careful study of a small group of patients* clearly shows the association of enlargement of the ileocecal valve and symptoms which are relieved by operation. Surgery is indicated in a few instances in which symptoms are severe and cannot be relieved by any other method. To the present time any type of surgery other than ileocecal resection has not been satisfactory. Enlargement of the ileocecal valve has been shown to be associated with intermittent relenting ileocecal intussusception in adults.

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Grateful acknowledgment is made to Drs. John P. McKibbin, John F. Menke, and James H. Yant for the use of their material and to Dr. Charles M. Blumenfeld for his interest and assistance in review and comments on pathologic material.

* Two more patients have been operated upon since the writing of the above report. One patient had a prolapse of mucosa with some edema of the valve and inflammatory reaction of the terminal ileum. The other had some inflammatory reaction and fatty accumulation in the submucosa of the valve. This patient had demonstrated one episode of ileocecal intussusception.

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Vol. 79, No. 5

THE ROENTGEN DIAGNOSIS OF ILEO-ILEAL INTUSSUSCEPTION*

By LEO G. RIGLER, M.D., *and* H. WILSON GODFREY, M.D.

THE mortality from intestinal intussusception has decreased markedly in the last fifteen years chiefly, no doubt, as a result of the earlier recognition of the condition and the prompt institution of appropriate therapy. The importance of these factors is well illustrated by Ravitch and McCune[9] who point out that the mortality for those treated in the first twenty-four hours is only 7.7 per cent, while for those treated after the symptoms have been present for forty-eight hours it is 54 per cent. That similar striking differences in mortality accompany delay in diagnosis beyond the forty-eight hours are indicated in almost all the reported series.

Ileo-ileal intussusception is far less common than the other varieties, constituting some 9 per cent in Gross'[3] series of 702 cases. While this percentage is not large, it represents a serious problem since Gibbs and Sutton[1] have reported a 62 per cent and Ravitch and McCune[9] a 71 per cent over-all mortality in the ileo-ileal group, a great disporportion as compared to other types of intussusception.

The high fatality rate of ileo-ileal intussusception appears to be a result of delayed diagnosis and this, in turn, is due to several factors. First of all, this type of intussusception exhibits a subacute, chronic, or chronic recurrent type of process rather frequently. The ileo-ileal form also tends to occur with a slightly greater frequency in the age group beyond two years; 41 per cent of intussusceptions in adults are enteric in location.[8] Such subacute or chronic intussusceptions, in the adult or juvenile, manifesting recurrent episodes of crampy abdominal pain, diarrhea and chronic weight loss with a vague history often go unrecognized. The findings are much less characteristic than the acute paroxysms of abdominal pain, vomiting, bloody stools and palpable mass found in the infant. The second reason for the delay is a failure to fully utilize roentgenologic diagnostic methods. Lawrence and Ulfelder,[5] in a review of 60 cases at the Massachusetts General Hospital from 1937 to 1951, reported that simple roentgenograms of the abdomen were of diagnostic aid in one-third of all the cases of intussusception, but of no value in the ileo-ileal type. Gross[3] states that a plain film study might show evidences of small bowel obstruction which might aid in diagnosis, but that barium enema examination was of no value in ileo-ileal intussusception. A third factor in the delay in diagnosis is that the full use of roentgenologic investigation, even under the most favorable circumstances, does not provide the same high percentage of positive results as in the ileo-colic and colo-colic intussusceptions in which the diagnosis by barium enema study may be made in at least 80 per cent or more of all the cases.[10]

METHODS OF ROENTGEN EXAMINATION AND ROENTGEN FINDINGS

The roentgen signs of ileo-ileal intussusception have been presented in conjunction with the general findings in intussusception by many authors; however, the case illustrations frequently have been chiefly those of the ileo-colic or colc-colic types. The majority of the roentgen signs of ileo-colic intussusception also apply to ileo-ileal intussusception.

Simple roentgenograms of the abdomen may be made and their value is shown to best advantage by Middlemiss[6] who, as a result of a review of 62 cases of all types of intussusception, concluded that abnormal findings were exhibited in every case. While

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these roentgenograms were not all specifically diagnostic, many showing only signs of partial or complete bowel obstruction, it was felt that the plain film of the abdomen could be used to screen out those cases in which intussusception was unlikely. In ileo-ileal intussusception, the evidences of a partial or complete bowel obstruction with multiple gas-distended small bowel loops and edema of the bowel wall are often seen. The character of the findings depends somewhat on the duration and completeness of the resultant obstruction. The chronic and chronic recurrent type may give symptoms over a long period without evidence of bowel obstruction either clinically or roentgenologically.

Certain specific roentgen signs, observed in roentgenograms of the abdomen without contrast, have been reported by a number of authors.[4,7,13] An area of increased radiability having the shape of a beak, resulting from the conical, tapered narrowing of the proximal lumen of the intussusceptum distended by gas, is a significant finding. If the intussusceptum is long and edematous, the gas within may be seen as a linear or curvilinear radiolucency within a soft tissue mass rather than the conical or funnel-like narrowing. Schatzki[11] and Williams[13] have reported a concentric encircling of the soft tissue mass of the intussusceptum by gas trapped between the walls of the intussusceptum and the intussuscipiens. In ileo-colic and colo-colic intussusceptions, the crescent shaped apex of the intussusceptum has been seen as a soft tissue mass in contrast with the gas-filled distal bowel; however, examples of this finding in the ileo-ileal type of intussusception were not found in the literature.

In cases in which the symptoms were of the chronic or subacute type, barium given orally with a follow-up examination of the small bowel has been of considerable value in the diagnosis of ileo-ileal intussusception. Good[2] has described 3 cases illustrating the use of this method. He reports a transient delay of the barium column which narrows as it enters the proximal intussusceptum. Narrow linear columns of barium passed down the lumen for the whole length of the intussusceptum. The same finding was previously reported in reviews by Sussman[12] and Schatzki.[11] Following progression beyond the apex of the intussusceptum the barium tends to flow in retrograde fashion between the walls of the intussusceptum and the intussuscipiens. This results in the "coil spring" outline of the intussusceptum mass which has been repeatedly described.

The roentgen findings obtained by barium enema examination depend entirely on reflux through the ileocecal valve into the terminal ileum. Such a retrograde flow results in invagination of the barium column by the convex apex of the intussusceptum, as noted in a case by Nordentoft.[7] Here again, the passage of barium between the walls of the intussusceptum and the intussuscipiens also results in the "coil spring" appearance.

Individual case reports showing some of the findings of ileo-ileal intussusception using a single type of roentgenologic study are found in the literature. The 3 cases described in this report illustrate some of the roentgenologic signs seen in the three commonly used methods of investigation; namely, the plain roentgenogram of the abdomen, the barium enema, and the oral barium small bowel study. In addition, a new sign, not hitherto reported, will be delineated.

REPORT OF CASES

CASE 1. K.B., a ten year old white female, was admitted to the Ancker Hospital, October 7, 1956, complaining of diffuse abdominal pain, nausea and vomiting, beginning about ten days prior to admission. The pain was cramp-like in nature, periodic in occurrence, located in the peri-umbilical area originally, but became diffuse after a period of time. Two bowel movements occurred during the week preceding admission, the last of which was a watery, diarrheal stool on the day of admission, but no blood was noted. There was no history of previous abdominal surgery. On physical examination the patient appeared fatigued and somewhat dehydrated with a temperature of 100°F. The abdomen was distended and tympanitic

and auscultation revealed high pitched, hypoactive bowel sounds. Muscle guarding and tenderness were present, and there was a suggestion of generalized rebound tenderness. Rectal examination showed bilateral tenderness but no blood. The leukocyte count was 14,600. Roentgen examination of the abdomen (Fig. 1) revealed a gaseous distention of many small bowel loops with thickening of the walls of the bowel in its proximal portion. A lateral decubitus view disclosed numerous gas and fluid levels with such extreme distention of the bowel that the pattern of the bowel wall had been lost. In the right upper quadrant (Fig. 1) a tapered, conical, highly radiolucent gas shadow was seen (arrow), apparently superimposed upon a dilated loop of small bowel. There was a soft tissue shadow about this conical radiolucency. No contrast studies were done. The above findings coupled with the clinical history enabled us to make the diagnosis of ileoileal intussusception.

With the roentgenologic and clinical picture of small bowel obstruction, the patient was explored. A marked distention of the entire small bowel was observed at surgery. Mesenteric adenitis was present, but there was no free fluid within the abdomen. An ileo-ileal intussusception was found, with approximately 9 cm. of normal ileum separating an 8 cm. intussuception mass from the ileo-cecal valve. The location corresponded exactly to the shadow seen in Figure 1. Reduction was attempted, but the wall was found to be gangrenous, and resection of a 22 cm. segment was required. Microscopic examination of the specimen showed hemorrhage throughout all the layers of the bowel but no etiology for the intussusception was found. The patient recovered.

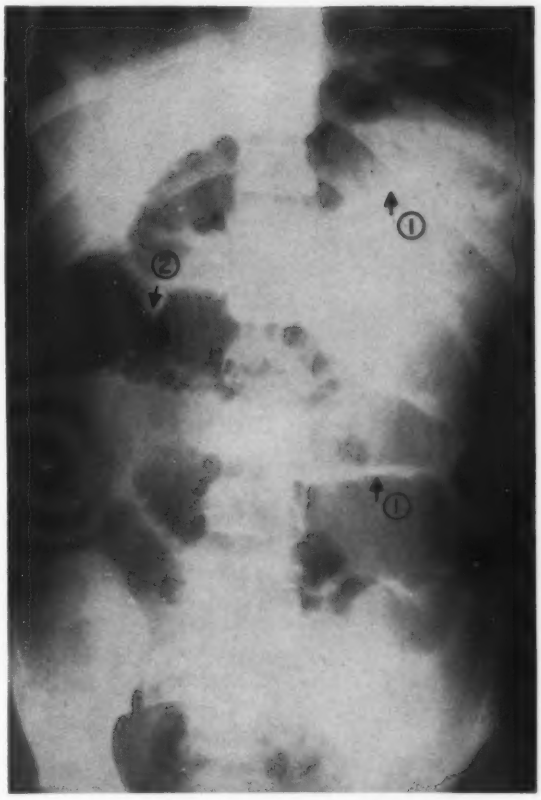

Fig. 1. Case 1. Roentgenogram of the abdomen in supine position, showing greatly distended loops of small bowel with unusually thick bowel wall (arrows No. 1). In the right upper quadrant there is a shadow of gas density (arrow No. 2) shaped like a bicycle seat which indicates the presence of ileo-ileal intussusception. This represents the gas-distended intussusception superimposed upon the dilated bowel loop. Note the soft tissue shadow separating it from the proximal gas-filled bowel.

Comment. The delay in treatment is characteristic. In contrast to the usual ileocolic intussusception, the symptoms were not violent enough to promote calling a physician. Such delay is often disastrous.

The gas shadow resembling a "bicycle seat," shown in Figure 1 (arrow), no doubt represented gas within the intussusceptum near its apex. The soft tissue shadow was the result of the contrast between the gas beyond the intussusceptum and that between its distal wall and the intussuscipiens.

Case II. I.S., a three month old well nourished infant, was well until the morning of admission on March 17, 1956, when he experienced a sudden onset of cramping abdominal pain. There were three bowel movements on the day of admission, the last two of which contained bright red blood.

Physical examination on admission to Children's Hospital showed the abdomen to be soft and relaxed. No abdominal masses were palpable. A right inguinal hernia was present and reduced easily. Rectal examination showed bright red blood on the examining finger.

Laboratory studies showed a normal hemoglobin and negative urinalysis. The leukocyte count was 9,700. Because of the suspicion of intussusception, a barium enema examination was done shortly after admission. The barium passed retrograde through the ileo-cecal valve into the ileum and there met with an obstruc-

FIG. 2. Case II. Roentgenogram after barium enema showing retrograde filling of ileum through the ileocecal valve. The dilated gas-filled proximal loop of the obstructed ileum (arrow No. 1) can be seen. The mass of the intussusception (arrow No. 2) is made out at the head of the barium column. Note the rings of barium between the folds.

tion, due, no doubt, to the caput of the intussusceptum. The defect in the small bowel was observed at fluoroscopy and confirmed by spot films and a conventional roentgenogram, shown in Figure 2 (arrows). The distended loop of bowel filled with gas proximal to the point of obstruction is well shown as is the invagination of the barium column by the intussusceptum.

At surgery an ileo-ileal intussusception mass was found 50 cm. proximal to the ileo-cecal valve. There was an inverted Meckel's diverticulum forming the apex of the intussusceptum. The segment of bowel was resected. Histologic examination of the diverticulum showed suppuration and early strangulation. The patient recovered without further event.

Comment. It is notable that the barium was passed through the ileo-cecal valve with relative ease for a distance of some 50 cm. This was fortunate for it permitted an unequivocal diagnosis to be made. This case illustrates the characteristic findings to be obtained when the ileo-ileal intussusception is close enough to the ileo-cecal valve for retrograde filling. The Meckel's diverticulum was not seen.

CASE III. A forty-seven year old white male was admitted to the Minneapolis Veterans' Hospital on January 22, 1957 for chronic diarrhea and weight loss. In September of 1946 the patient had a subtotal gastrectomy for duodenal ulcer. He was again admitted on several occasions for various symptoms which appeared to be psychogenic in nature. On December 26, 1956 the patient was given achromycin therapy for a facial furuncle. On the second day of therapy he developed loose stools which persisted until admission on January 22, 1957. At this time he complained of vomiting, inability to eat solid foods and undigested food material in the stool. His weight had dropped from 130 pounds to 107 pounds in the three weeks prior to admission. No blood or mucus had been noted in the stools.

Physical examination showed an under-nourished, depressed, white male with a left upper abdominal gastrectomy scar and mild epigastric tenderness. There were no palpable masses, and bowel sounds were normal. Rectal examination also was negative.

Laboratory studies showed a leuckocyte count of 13,000 and hemoglobin of 15 gm. Albuminuria was present. No ova or parasites were found in the stools.

Upper gastrointestinal roentgenologic examination on January 29, 1957 showed a subtotal gastrectomy with a Billroth II type anastomosis and normal emptying rate. At two hours a small bowel follow-up roentgenogram showed an area suspicious for intussusception. Because of this, the examination was repeated on February 6, 1957, and characteristic intussusception masses were seen. In fact, at least three different areas of apparent intussusception in the small bowel were made out. One of these is well illustrated in the roentgenogram shown in Figure 3. The characteristic "coil-spring" appearance in the ileum and the dilatation proximal to it are well shown.

Since this was obviously a chronic process, surgery was not undertaken. A repeated examination the following day showed complete disappearance of the intussusceptions which sug-

gested that this was an intermittent acute process which was able to reduce itself.

The patient was placed on a medical regimen, and three days later was asymptomatic. He was discharged with the diagnosis of acute enterocolitis due to antibiotic therapy with associated transient ileo-ileal intussusception.

Comment. In this case the diagnosis was not established at surgery, but the picture is so characteristic that it seems reasonable to assume that an ileo-ileal intussusception has been present. The case demonstrates the characteristic roentgen finding when the small bowel is examined after ingestion of the barium meal.

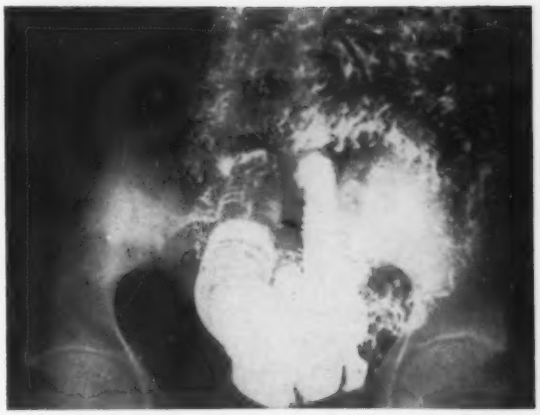

Fig. 3. Case III. Roentgenogram exhibiting small bowel one and one-half hours after barium meal. The characteristic "coil-spring" appearance of the intussusception (arrow) is well shown. There is also seen dilatation of the bowel proximal to the point of obstruction.

DISCUSSION

The 3 cases detailed here illustrate the various and typical findings seen in intussusception when multiple roentgen diagnostic procedures are undertaken. It seems clear from these that a preoperative diagnosis of the ileo-ileal intussusception is frequently possible when full use is made of all the roentgen diagnostic methods which are available. While the diagnostic accuracy will not equal that of the application of such methods to the other types of intussusception, the high incidence of mortality in ileo-ileal intussusception justifies a full roentgenologic investigation of all cases with a suggestive clinical history.

In addition to the common signs previously described, we are directing attention to a roentgen sign (Fig. 1) apparently not heretofore reported. A shadow of gas density resembling a "bicycle seat" in shape, resulting from the constriction of the intussusceptum, may be found in cases of ileo-ileal intussusception. We have not observed this in typical form in other cases, but the number examined by plain roentgenograms of the abdomen are small. The appearance corresponds so well with the anatomic findings that it seems probable that it may occur with some frequency. It is possible that observation of this sign, together with roentgen evidences of small bowel obstruction, may lead to a definitive diagnosis of ileo-ileal intussusception based on simple roentgenograms of the abdomen without contrast.

SUMMARY

1. The roentgen findings in intussusception in general are briefly reviewed, and it is noted that most of these findings are also applicable to ileo-ileal intussusception.

2. Three cases are presented showing the various roentgenologic findings in ileo-ileal intussusception obtained by three methods of investigation.

3. These cases are presented to encourage careful scrutiny for the findings of ileo-ileal intussusception in the hope that, through earlier recognition, the high mortality may be lowered.

4. A sign not previously reported which seems to be indicative of ileo-ileal intussusception and can be observed in simple roentgenograms of the abdomen is delineated.

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Appreciation is acknowledged to the staffs of the Ancker Hospital in St. Paul, the Children's Hospital in St. Paul and the Minneapolis Veterans' Hospital for permission to publish these cases.

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VOL. 79, NO. 5

LIPOMAS OF THE COLON

WITH REPORT OF FIVE CASES

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LIPOMAS represent the second most common benign tumor of the colon. Helwig[3] found 139 adenomas, 13 lipomas, 1 carcinoid and 1 leiomyoma in a series of 154 benign tumors of the colon. Kirschbaum[4] reviewed 5,734 autopsies and found 33 benign mesenchymal tumors in the gastrointestinal tract. Only 2 of the 33 were in the colon and both were lipomas. Palazzo and Schulz[8] reported on 140 cases of spindle cell tumors in the gastrointestinal tract but only 12 of these were in the colon. Of these 12, only 1 was a benign spindle cell tumor and 7 of the 12 were first recognized at surgery. In another article Palazzo[7] reported 36 cases of lipoma of the gastrointestinal tract with 20 of these being located in the colon. Also, it is of interest to note that a colon examination was performed in 9 of these and the tumor was recognized in 8.

Pack and Booher[6] reviewed the literature in 1947 and found that 153 cases of lipoma of the colon had been reported, including their own. Mayo and Griess[5] added 19 cases in 1949. There have been several case reports since 1949.

About one-half of the lipomas occur in the cecum and ascending colon.[5,7] Most are submucosal in location but they may be intramuscular, intermuscular or subserosal.[7,14] Lipomas may be flat, sessile or pedunculated. Intussusception occurs in about 50 per cent of the symptomatic cases.[7,12] In 11 of 94 cases reviewed by Pemberton and McCormack[9] the lipomas passed spontaneously. They apparently never become malignant.

Comfort[1] states that the development of collection of fat cells into a single lipoma can be a possible explanation for the origin of lipomas in the colon. It is known that adult fat cells are present in all connective tissue and are present, though not abundantly, throughout the gastrointestinal tract.

The symptomatology is not specific. Comfort,[1] in his review, reported that 74 of 92 large intestinal lipomas caused symptoms. The symptoms depend upon the size, location and behavior. There may be obstruction varying from constipation to acute obstruction or, on occasions, alternating diarrhea and constipation. Ulceration, necrosis and secondary inflammation are not uncommon. The history may suggest a benign lesion. Pemberton and McCormack[9] noted an average duration of symptoms of 41.5 months. The average age is slightly over fifty with about an equal frequency of males and females.

It has been repeatedly emphasized in the literature that the diagnosis of a lipoma cannot be made before surgery except in those cases in which they have passed spontaneously, or on observing the tumor which has intussuscepted to the rectum. On several occasions, however, the diagnosis has been offered as a possibility before surgery. In 2 of Mayo and Griess'[5] 19 cases the possibility was mentioned on the basis of the roentgen examination of the colon. Palazzo[7] described the roentgenographic appearance of a lipoma but felt that it could not be differentiated from other benign mesenchymal tumors and often could not be differentiated from malignancies. Golden[2] reported one case where the intussuscepted tumor was recognized as being slightly more radiolucent than the surrounding soft tissue on a plain roentgenogram of the abdomen.

There had been 5 cases of lipomas of the colon at the Mississippi Baptist Hospital in the last six years. All of these were studied by a roentgenologic colon exami-

nation prior to surgical exploration. The diagnosis was suggested in 3 of the 5 cases. The first 3 cases illustrate the reasons why lipoma was considered as a possibility.

REPORT OF CASES

CASE I. This thirty-eight year old white female had a history suggesting a partial intermittent intestinal obstruction of five years' duration. Roentgenologic colon studies on two occasions revealed a 2.5 cm. sessile lesion in the cecum, just adjacent to the ileocecal valve. Because of the smooth, well-demarcated outline, it was felt that the tumor could be a lipoma (Fig. 1).

An exploratory laparotomy was performed and a 2.5 cm. sessile mass was found just above and immediately adjacent to the ileocecal valve. It was removed by an elliptical excision.

The lesion was found to be a submucosal lipoma, smooth in appearance and yellow on the cut surface. The microscopic study showed adult fat cells.

This patient made an uneventful recovery with complete relief of symptoms, and it was felt that this small lipoma had intermittently obstructed the ileocecal valve for the past five years.

CASE II. A forty-four year old obese female was admitted with a history of intermittent pain in the left lower abdomen for the past year. On two occasions she had experienced some rectal bleeding with the passage of dark clots of blood. There was no weight loss and the physical examination was not remarkable. No masses could be palpated in the abdomen.

A roentgenologic colon examination revealed a smooth, ovoid 3×4 cm. mass in the proximal sigmoid which had the appearance of an intramural extramucosal tumor (Fig. 2). It was felt that this mass was softer than the usual adenomatous tumor. A positive diagnosis of a lipoma could not be made but the findings were considered as more suggestive of a lipoma than an adenomatous tumor.

An exploratory laparotomy was carried out and the lipoma was resected. Grossly two-thirds of the specimen was bare. On transverse section it had a glistening yellow color. The microscopic appearance was that of adult fat cells but with some subacute inflammation in that part of the lipoma not covered by mucosa. The patient had a complete recovery with relief of symptoms.

CASE III. This sixty year old white male was admitted to the hospital because of rectal bleeding on several occasions in the past two years. A physical examination was noncontributory. He was not obese and no masses could be palpated in the abdomen.

A roentgenologic colon examination revealed a 5×4×4.5 cm. slightly lobulated mass in the transverse colon, having smooth margins (Fig. 3). The tumor appeared to be somewhat compressible on the multiple spot roentgenograms. Air contrast studies were also done and these showed the mass to have almost the same density as the surrounding air-filled colon (Fig. 4). The impression was that this was a benign tumor, most likely a lipoma. At surgery the lipoma was identified and a limited resection carried out.

The pathologist described this tumor as a soft mass, fairly fluctuant to palpation. It was submucosal in location but not completely covered by the mucosa. On transverse section of the mass it was seen to be composed of bright yellow fatty tissue. The microscopic study showed adult fat cells with some subacute inflammation in that part not completely covered by the mucosa.

The patient recovered without any difficulty and has had no further bleeding.

CASE IV. This fifty-five year old white female was admitted to the hospital because of blood and mucus in the stools for the past five weeks. There had been some dull aching in the upper abdomen for the past three months. Diarrhea

FIG. 1. The smooth margins of this lipoma of the ascending colon at the ileocecal valve are in contrast to the verruciform appearance of the usual adenomatous tumor.

was noted on occasions, the stool varying from liquid to semisolid consistency. There had also been a 10 pound weight loss in the past two months. Some tenderness was present in the upper abdomen but no masses could be palpated.

A roentgenologic colon examination revealed a pedunculated mass in the proximal transverse colon, measuring 5 cm. in diameter (Fig. 5). This was a well demarcated lesion but with considerable irregularity in the mucosal pattern. Just proximal to the tumor there was noted a mild constriction and dimpling of the colon. The impression was that this was a fungating lesion, most likely a carcinoma.

An exploratory laparotomy revealed a fungating, necrotic tumor mass at the junction of the middle and right thirds of the transverse colon. A section of the transverse colon was removed and an end-to-end anastomosis done.

The gross description of the lesion, which included 14 cm. of large intestine, was that of a pedunculated submucosal tumor, measuring 4 cm. in diameter and 2.8 cm. in elevation. There was an area of dimpling of the mucosa of the colon proximal to the mass. Around the base of the tumor there was normal appearing mucosa but over the major portion of the surface there was a greenish-brown material which appeared to be necrotic tumor tissue. The surface was irregularly contoured. The cut surface showed a narrow outer zone of brown tissue, but at the apex there was pinkish-white tissue. The remaining portion was pale yellow in color. The microscopic description showed that the mucosa was absent over much of the outer surface and this was covered by a thin layer of fibrin and neutrophils. Beneath this, there were scattered groups of fat cells and fibrous tissue. This fibrous tissue was described as being extremely vascular and diffusely infiltrated with plasma cells and a moderate number of neutrophils. There were areas of recent hemorrhage and other areas in which abundant hemosiderin was present. Deeper beneath the surface of the tumor there were large lobules of fat cells separated by varying amounts of connective tissue septa. There was no evidence of malignancy.

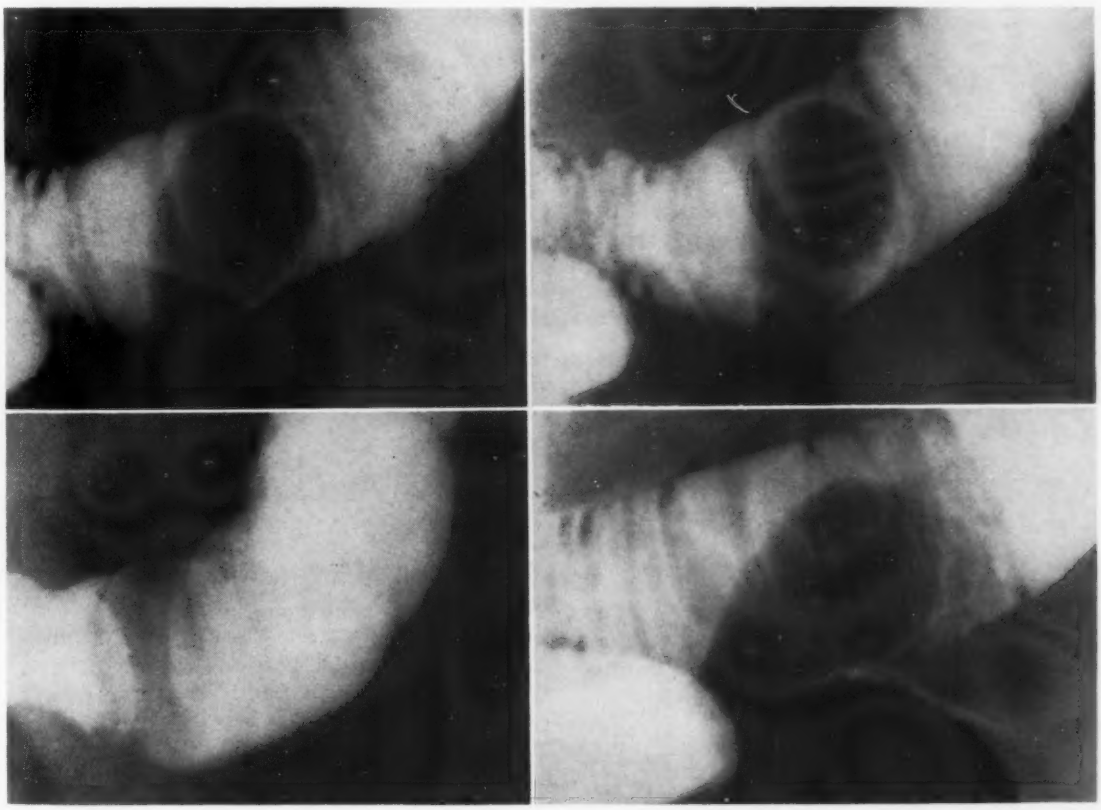

Fig. 2. A classic example of an intramural extramucosal tumor. The fluctuant nature of the lipoma is felt to be demonstrated on these compression roentgenograms.

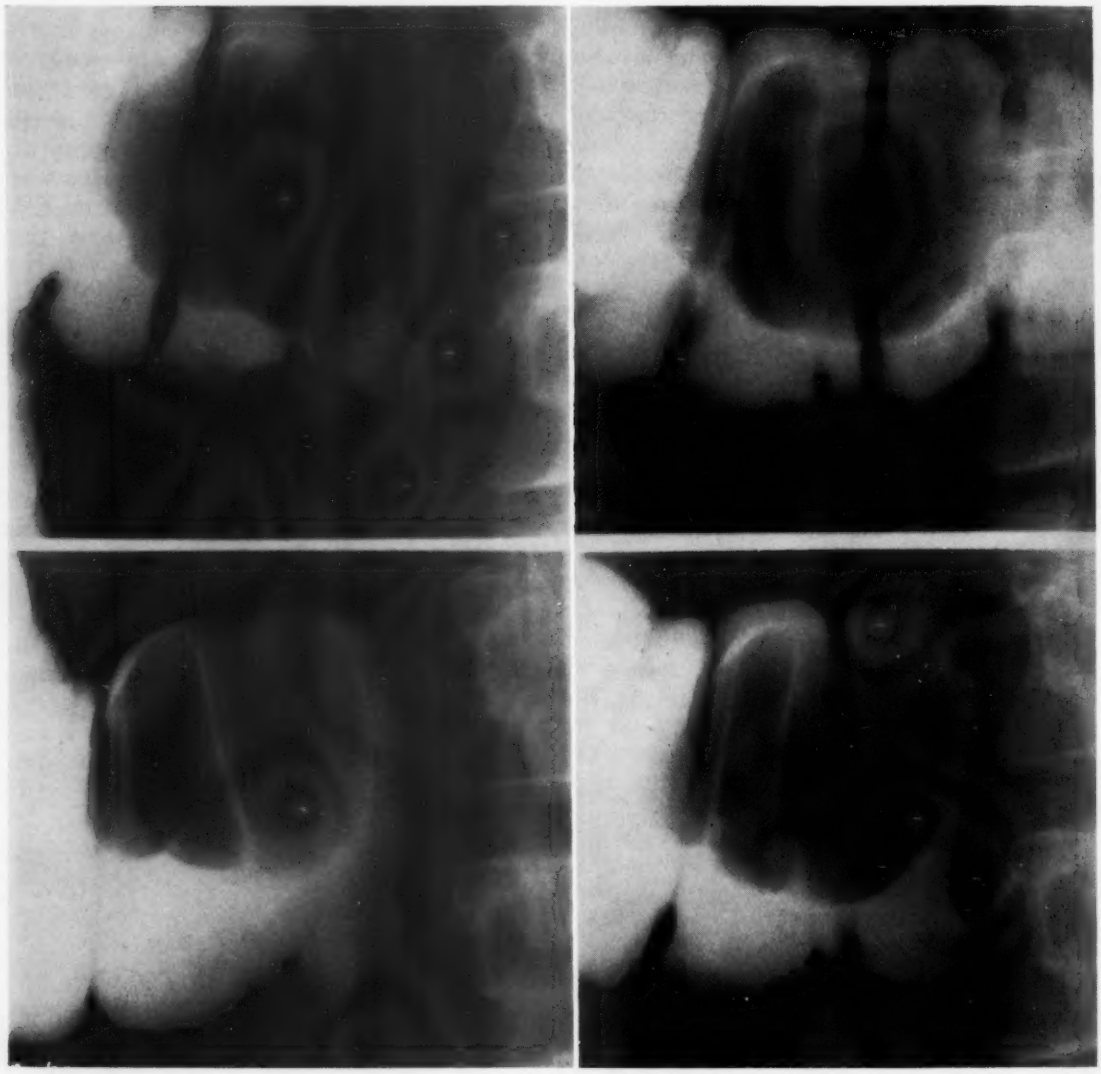

FIG. 3. This lipoma in the transverse colon does not appear to be quite as soft on compression as in the second case, but there is a suggestion of a slight change in contour with compression on these four spot roentgenograms. The smooth margins and the mild lobulation are well demonstrated.

The patient made an uneventful recovery and has been asymptomatic since the operation.

CASE V. A seventy-six year old white female was admitted with typical symptoms of cholelithiasis. A cholecystogram showed a nonfunctioning gallbladder. At this time a barium enema examination was also done and in the postevacuation roentgenogram only a radiolucency was demonstrated, measuring 2.5×1.5 cm. (Fig. 6). It was suggested that a repeat barium enema study be made, but since the surgeons planned to do a cholecystectomy they decided to check this suspicious finding in the hepatic flexure at the time of operation. After the cholecystectomy the hepatic flexure of the colon was incised, and a small sessile lesion was removed by an elliptical excision.

The gross description was that the specimen consisted of a roughly ovoid-shaped piece of tissue measuring 2.3×2 cm. The specimen was covered by a gray, thin mucous membrane. The membrane covered the supporting tissue, which was made up of yellow homogeneous fat. The diagnosis was that of a submucosal lipoma of the colon.

COMMENTS

Although lipomas can be easily recognized in the subcutaneous tissue by roentgenographic examination, the amount of soft tissue and osseous structures in proportion to the size of the lipoma makes it impossible in practically all cases to recognize on plain roentgenograms of the abdomen. None of these cases were recognized on conventional roentgenograms of the abdomen. With the roentgen examination of the colon the lipomas could be readily visualized as filling defects, but they did not appear to be more radiolucent than any other tumor in the colon. Phantom studies were carried out in an attempt to verify this, consisting of 5 cm. cubes of ice and fat within a cylinder of barium sulfate solution. On roentgenograms at 60 kv. no differential density between fat and water could be determined.

Double contrast studies might be of help. In Case II the tumor was not too well outlined and had about the same density as the surrounding air-filled colon (Fig. 4). Weber, in a personal communication to Pemberton and McCormack,[9] stated that it had been possible to suspect the true histologic nature by this method.

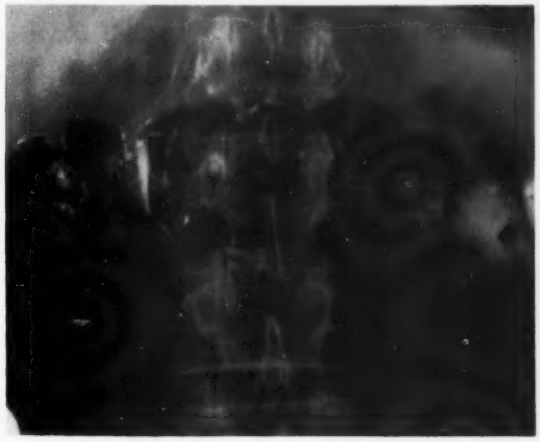

Fig. 4. The lipoma in the transverse colon appears to be about the same density as the surrounding air in this air contrast examination. If there had been more barium adhering to the walls of the colon and the mass, it may well have better demonstrated the lesion; but even with an air contrast examination, a tumor of this size is usually considerably denser than the surrounding air filled colon.

Fig. 5. The not uncommon complications of ulceration and inflammation have changed the appearance of this lipomatous tumor. It was thought that this was most likely a malignancy of the colon, and it was not until the excised specimen was studied grossly that the lipomatous nature of the tumor was recognized. This spot roentgenogram has very poor detail but the irregular margins can be identified.

Since the radiolucency of a lipoma cannot be recognized on conventional colon examination, other characteristics have to be evaluated. The typical lipoma is an intramural extramucosal tumor as described by Schatzki and Hawes.[11] It may be lobulated but the margins are smooth and the base is usually broad. The lipoma should be softer than other tumors and it was felt that Cases II and III illustrated this point when compression was used (Fig. 2 and 3). The lipoma did not encircle the colon as a malignancy does on many occasions.

In considering the differential diagnosis, the adenomatous growths have a verruciform margin. Again, compression spot roentgenograms are of help because the margins of the growth may not be clearly outlined within the barium-filled colon without compression.

Other than possibly the fluctuant character of a lipoma, the distinction between a

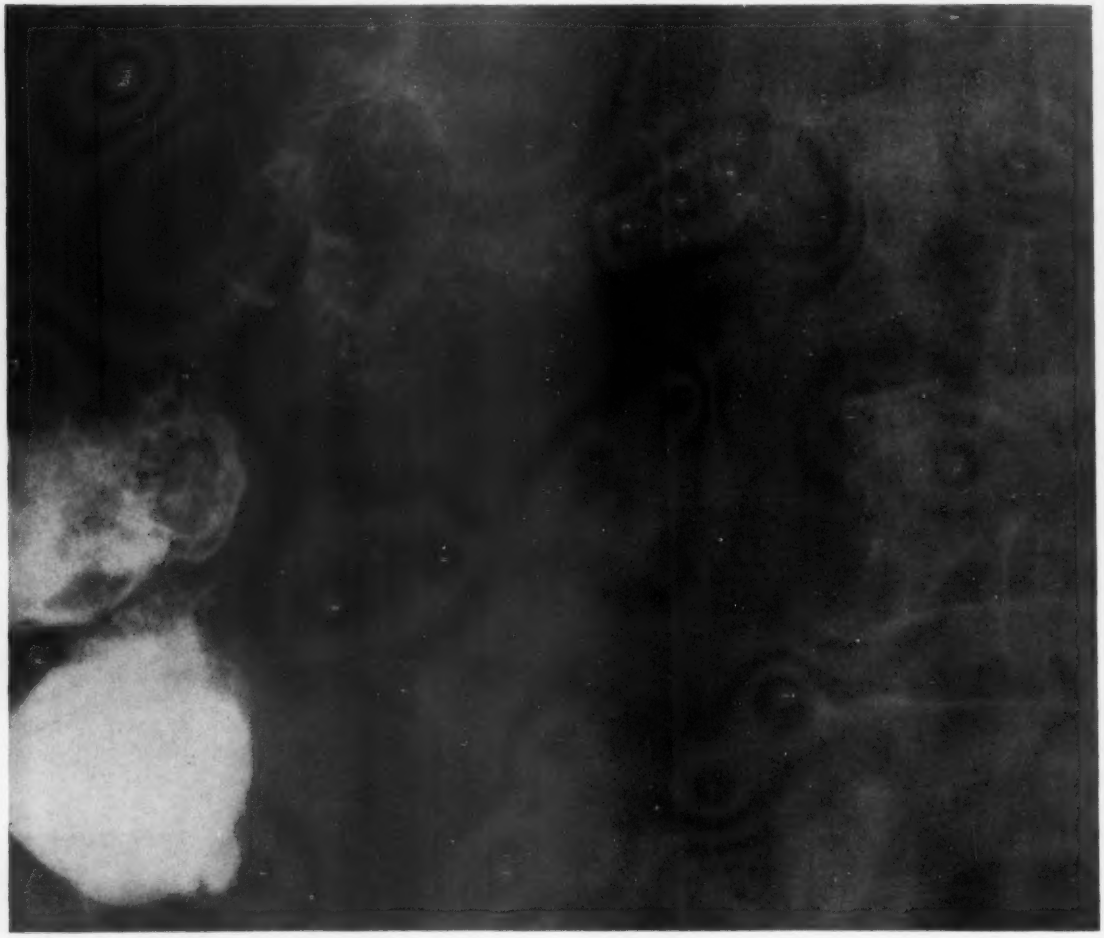

FIG. 6. This smooth ovoid mass was demonstrated on the evacuation roentgenogram only. No further studies were done because the lipoma was removed the next day following the cholecystectomy. It would have been interesting to study this lesion with compression spot roentgenograms and with an air contrast examination.

leiomyoma and a lipoma cannot be made, but lipomas are much more common than leiomyomas in the colon. If benign leiomyomas only are considered, it is felt that Helwig's[3] series of 139 adenomas, 13 lipomas, 1 carcinoid and 1 leiomyoma is a reasonable example of the relative frequency. Of course, with the malignant spindle cell tumors included there would be a higher percentage, but certainly a fair percentage of these should show some malignant characteristics to be of aid in exclusion. The one case of a leiomyosarcoma of the colon, found in the past five years at the Mississippi Baptist Hospital, had obvious malignant characteristics and involved the proximal one-half of the ascending colon. Carcinoids are uncommon in the colon and are most often located in the rectum,[13] an area easily examined by sigmoidoscopy. The frequency of intussusception in symptomatic lipomas is so high that this also would be of help in suggesting a differential diagnosis. Schatzki[10] reported that 3 of 10 cases of intussusception in an adult were caused by lipomas, with the other 7 being due to carcinomas.

Surgery is the only treatment and excision is indicated on all patients with a tumor of the colon regardless of the roentgenographic impression as to the nature of the tumor. Lipomas do not become malignant,

but they are symptomatic in over 80 per cent of the cases.[1] However, it may well mean a limited resection or a simple excision if the surgeon is offered the opinion that the lesion might be a benign one and that a lipoma would be a possibility.

CONCLUSION

1. Lipoma is the second most common benign tumor of the colon.

2. The characteristic appearance of a lipoma, present in 2 of the 5 cases, was that of an intramural extramucosal tumor with smooth margins, slightly lobulated and with a broad base. Another case had the smooth margins and broad base but was not lobulated.

3. Lipomas tend to be softer than other tumors when compression is used, as seen in 2 of the 5 cases.

4. The possibility of a lipoma should be considered in any case of intussusception in an adult.

5. Even a suggestive diagnosis to the surgeon might help limit the resection and make it easier for him to locate a soft lipoma at the time of operation.

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LYMPHATIC CYST OF THE TRANSVERSE COLON

REPORT OF A CASE

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A FILLING defect that is demonstrated within the lumen of the colon on barium enema examination is usually considered to be a polyp. This does not signify the character of the lesion, but most often it is considered to be an adenomatous polyp which may be benign or malignant. This paper is written to report a case of a filling defect that histologically proved to be a lymphatic cyst. The case was believed to be interesting because of the rarity of the lesion and since it was thought preoperatively to be an adenomatous polyp.

REPORT OF A CASE

E.H., a forty-nine year old white female, was referred on October 23, 1956, for a barium enema examination because of chief complaints of vague abdominal cramps and pain for two years and occasional bright red blood following a stool. At seventeen years of age, she had an appendectomy and at 48 years, hysterectomy, hemorroidectomy and fissurectomy.

Physical examination revealed a well nourished white female in no distress. There was slight mid-epigastric pain on deep palpation. The remainder of the physical examination was noncontributory.

Barium enema study on October 23, 1956, revealed many diverticula irregularly distributed along the colon, and in the proximal transverse colon there was noted a smooth, sharply defined polypoid filling defect thought to be slightly movable (Fig. 1 and 2). This produced no obstruction to the retrograde flow of barium and re-examination after evacuation revealed good emptying proximal to the lesion. This was interpreted as a polyp with a sessile base, probably malignant.

On November 30, 1956, a laparotomy was performed. Upon entering the peritoneal cavity, there were noted adhesions to the anterior abdominal wall and also from the small bowel to the bladder and to the right lateral pelvic wall, probably from previous surgery. There was also a lesion in the proximal third of the transverse colon, which was palpated and felt to represent a polyp. There was no indentation of the serosa of the bowel and no lymph nodes were found in the mesentery. The remainder of the abdominal cavity was negative except for multiple diverticula of the large bowel. The bowel was clamped and the colon containing the lesion was resected. The bowel, proximal and distal to the site of resection, was examined with an endoscope and no other lesion was seen.

The specimen was examined by the pathologist and showed a cyst approximately 3 cm. in diameter containing a dark yellow, clear thin fluid. The cyst was lined by a glistening gray membrane, streaked by prominent blood vessels. It was lying within the intact muscular layers of the bowel, and the overlying serosa was not remarkable. The gross specimen is shown in Figure 3 with the cyst ruptured.

Microscopic Report. The microscopic examina-

FIG. 1. Filling defect is noted in the proximal one-third of the transverse colon. Also there are many diverticula irregularly distributed along the colon.

tion showed the cyst to be lined by a sparse single layer of flattened cells with fusiform nuclei. A 20 to 30 mm. layer of condensed collagen bearing connective tissue rimmed the space and tortuous smaller spaces, leading from it into the submucosa. The congested blood vessels noted grossly were seen in the section, as well as an island of mucosa and muscle beneath the overlying mucosa and resembling a diverticulum cut tangentially. The lesion was thought to be a lympatic cyst, similar to that recently described by Koenig *et al.*[15] (Fig. 4).

Diagnosis. Lymphatic submucosal cyst of transverse colon (Maj. John Fust, Pathologist).

The patient was re-examined by barium enema on January 11, 1956, approximately six weeks postoperatively and showed some narrowing of the lumen at the site of resection. She still noted a little bright red blood occasionally following a stool and a small anal fisure was found to account for this.

SYMPTOMS AND CLINICAL FINDINGS

Benign tumors of the colon, except for polyps, may remain asymptomatic for years. Clinical symptoms depend on the size and location of the lesion and occur only after the lesion has enlarged sufficiently to produce partial obstructive signs, such as intermittent cramping. As the lesion enlarges, it may cause obstruction or intussusception and the patient may complain of pain, nausea and vomiting. Blood in the stools is not common, but will appear when ulceration in the mucosa overlying the tumor occurs.

Fig. 2. Spot roentgenogram of the lesion showing the smooth and sharply defined margins.

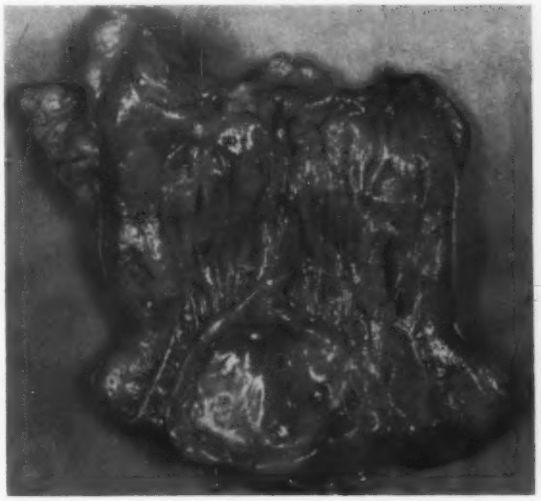

Fig. 3. The cyst, which is ruptured, is seen at the inferior margin of the specimen.

DISCUSSION

In 1,460 consecutive autopsies, Helwig[12] found 154 benign tumors in the large intestine. These consisted of 139 adenomas, 13 lipomas, 1 carcinoid and 1 leiomyoma.

Lymphatic cysts and/or lymphangiomas of the colon are rare benign tumors. Koenig, Claudon and Byrne[15] recently reported a case of a lymphatic cyst, with a microscopic appearance very similar to the present case. Eleven cases of lymphangioma of the gastrointestinal tract were found reported in the English literature.[1,4–6,8,16–20,22]

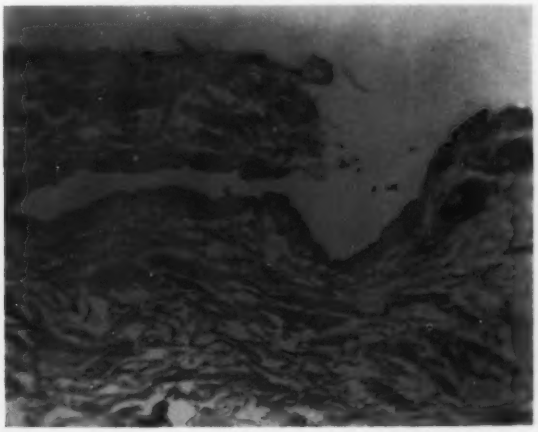

Fig. 4. Section through the cyst shows wrinkling of the wall after relaxation. There are blood vessels just beneath the surface. Lining cells are sparse and thin (×185).

Six arose in the jejunum or ileum and 5 in the colon. Of the latter group, 3 were in the rectum, 1 in the ascending colon and 1 in the transverse colon. In discussing the lymphangioma of the transverse colon, reported by Byrne and Morton,[4] Dr. Robert C. Horn Jr., stated, "This lesion is identical with some we have encountered not too rarely in the small intestine, but not in the colon. There have been incidental autopsy findings, presenting as small, soft, yellow, sometimes multiple polyps. We have classified them as cavernous lymphangiomas, just as a number of blood vascular lesions are classified as angiomas, although they are probably really malformations."

Beahrs, Judd, and Dockerty[3] offered the following classification of abdominal cysts:

Embryonic and Developmental Cysts. This group includes enteric, urogenital, lymphoid and dermoid cysts. It would also include embryonic defects in early formations of lymphatic vessels and lymph nodes.

Traumatic or Acquired Cysts. Cysts caused by forcible injury, which in turn cause hemorrhage resulting in sanguineous cysts or rupture of lacteals with extravasation of chyle into surrounding tissue are included in this group.

Neoplastic Cysts. This group, divided into benign and malignant, includes those cysts in which there is evidence of true new growth. In the benign group there may be hyperplasia of lymphoid vessels, resulting in a lymphangioma. Lymphangio-endothelioma would be classified in the malignant group.

Infective and Degenerative Cysts. Classified in this group are cysts of mycotic, parasitic or tuberculous origin. Cystic degeneration of lymph nodes and other tissue would also be included.

One factor that has been responsible for the confusion in the classification of abdominal cysts has been the tendency to classify them according to contents. Marsupialized chylous cysts do not drain chyle; they usually heal in a few weeks with moderate discharge of serous exudate.[9] Higgins and Lloyd[13] state that "such adjectives as lymphatic, chylous, and sanguineous merely denote accidents which may befall cysts, and they have no precise bearing on the problems of etiology."

Of the cysts connected with or adjacent to the intestinal tract, the enteric (enterogenous) cyst is probably the most common. There are many reports in the literature of enterogenous cysts, and these occur most frequently in the ileocecal region, although some have been reported in the rectosigmoid area.

The present case is of particular interest because this patient had noted small amounts of bright red blood on the tissue paper following a stool and on barium enema examination a smooth polypoid filling defect was demonstrated. This was thought to represent an adenomatous polyp, probably malignant. In retrospect, there do not appear to be any features which would help in differentiating this cyst from an adenomatous polyp.

PATHOGENESIS

Lymphatic cysts probably do not have a common origin. Hadley[10] believes that the only way to determine the nature of a cystic tumor is to study its history, its location, the structures of its walls and the character of its contents. These cysts may be preformed as suggested by Dowd[7] or may represent developmental anomalies as mentioned by Arzela[2] and Handfield-Jones;[11] however, the possibility of trauma or inflammation should be considered in some cases.[3]

Gerster[9] states "that lymph cysts and chyle cysts of the abdomen arise from lymphatics of the retroperitoneal region or from chyle bearing lymphatics of the intestine. They may start retroperitoneally and push forward between the leaves of the mesentery or vice versa. The mesenteric forms are by far more frequent. The peritoneal forms are much rarer."

Wegner[21] and later Gerster have shown that cystic lymphagiomas may arise from cavernous lymphangiomas and may have

cavernous lymphatic tissue in their walls. Cystic lymphangiomas may have almost no connection with nearby lymphatics.

Treatment of lymphatic cysts will be determined by the size and location of the lesion. When benign and well encapsulated, as this case was, a simple enucleation would suffice; however, it is felt that resection of the bowel is preferable since Beahrs, Judd, and Dockerty reported that in a group of 9 chylous cysts 2 were found to be malignant. Also, a large diverticulum may occur at the site of the cystic lesion after removal, due to weakening of the wall. The author has seen this occur in the removal of an enterogenous cyst from the wall of the esophagus.

SUMMARY

A case of a benign submucosal lymphatic cyst of the transverse colon in a forty-nine year old white female is reported. This was removed by resection of the involved bowel.

On roentgen examination there was a polypoid filling defect, interpreted as an adenomatous polyp. In retrospect, no roentgenologic features are recognized which could differentiate the lymphatic cyst from a polyp.

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FISTULOUS TRACTS WITH INTESTINAL COMMUNICATION SECONDARY TO ABSCESS FORMATION IN DIVERTICULITIS*

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THE most common complications of diverticulosis of the colon are inflammation, hemorrhage, obstruction, perforation and fistula formation. These complications may occur alone or in combination with others and all have been described in the literature.[1,2,3,5,6,8,10,11]

Rarely a diverticulum may perforate suddenly with wide-spread spillage of intestinal contents throughout the peritoneal cavity resulting in peritonitis and even death. Usually the perforation is slow and is quickly sealed off by omentum and intestine forming a localized abscess. Goulard and Hampton[4] believed perforation of a diverticulum and abscess formation to be relatively common. Fistulae sometimes develop from such abscesses and Bockus[1] states that these fistulae may extend into the bladder, the ureter, the intestine, the skin or to surrounding structures leaving a secondary abscess. Schinz *et al.*[9] report that perforation from diverticula or carcinomas usually occurs in the distal or middle third of the sigmoid and that cases of pericolic abscesses becoming chronic and perforating back into the colon have been observed. Mayo and Blunt,[7] reporting on 202 operative cases between 1939 and 1948, found fistulous communication between the sigmoid and colon in only 3 cases. Wolf, Khilnani and Marshak[12] include 4 cases of submucosal sinus tract formation in their article on diverticulosis and diverticulitis.

The purpose of this paper is to present the clinical, roentgenographic and pathologic findings in 8 unusual cases in which fistulous tracts developed either with communications in the colon or with adjacent loops of small bowel. In 6 patients (Case I to VI) the original abscesses had drained through sinus tracts which paralleled the colon and pierced the lumen at multiple points forming colocolic fistulae. In 2 patients (Case VII and VIII) the abscesses had perforated and drained into the adjacent small bowel.

REPORT OF CASES

Case I (D.G.). This eighty year old white female was admitted to the hospital on June 15, 1953 because of abdominal distention, pain and vomiting. Eight months prior to the present admission, she had been hospitalized with diverticulitis (Fig. 1). The present illness had started about one week previously with diarrhea followed by constipation. This was followed by abdominal distention and generalized cramp-like pain.

Physical examination revealed marked abdominal distention with absent peristalsis. Ab-

Fig. 1. Case I. A barium enema study October 20, 1952 revealed diverticula and a 2.0 cm. defect above the superior margin of the sigmoid consistent with diverticulitis and localized abscess. A ventral hernia was also demonstrated.

* Presented at the Fifty-eighth Annual Meeting of the American Roentgen Ray Society, Washington, D. C., October 1–4, 1957.
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dominal roentgenograms demonstrated a large bowel obstruction, probably in the lower descending colon. On the day of admission a cecostomy was performed. Seven days later a barium enema study (Fig. 2) showed diverticula and a 14.0 cm. long fistulous tract, coursing along the superior margin of the sigmoid and descending colon. Another tract led caudad for 8.0 cm. puddling in an abscess cavity. Eleven days after admission she underwent a transverse colostomy. Following this the patient returned home and refused further treatment. She subsequently died, of myocardial infarction, eleven months later.

Case II (C.L.). A seventy-four year old white male was admitted to the hospital on November 18, 1953 with a complaint of rectal bleeding of one day's duration. He had had chronic constipation and twenty-four hours prior to admission had taken a laxative. This was followed by crampy abdominal pain and two bloody bowel movements.

Fig. 2. Case I. Eight months later a long fistulous tract, measuring 14.0 cm. in length, medial to the descending colon and sigmoid filled with barium and there were multiple areas of communication with the lumen of the intestine. Another fistulous tract extended caudad to the right of the rectum, puddling in an abscess.

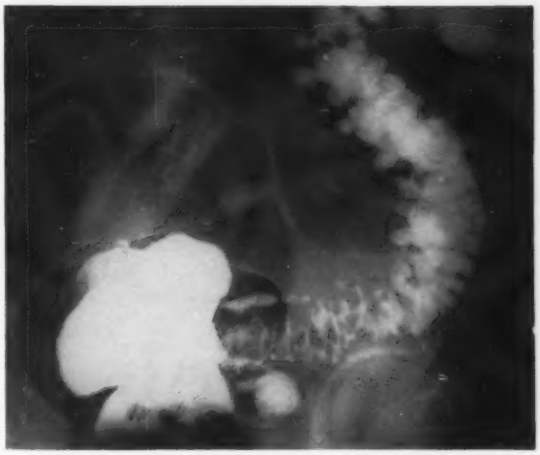

Fig. 3. Case II. A partial barium enema study revealed multiple diverticula in the sigmoid and descending colon. A sinus tract 5.0 cm. in length filled above the sigmoid and drained into the narrowed lumen in several places. Inferior to the sigmoid was a large abscess cavity.

Physical examination revealed a tender 7.0 cm. mass in the left lower quadrant. A partial barium enema study (Fig. 3 and 4) demonstrated multiple diverticula in the sigmoid and descending colon. A sinus tract 5.0 cm. long filled above the superior margin of the sigmoid and communicated with the lumen of the bowel at several points. Inferior to the midsigmoid

Fig. 4. Case II. A localized view of the sigmoid and sinus tract.

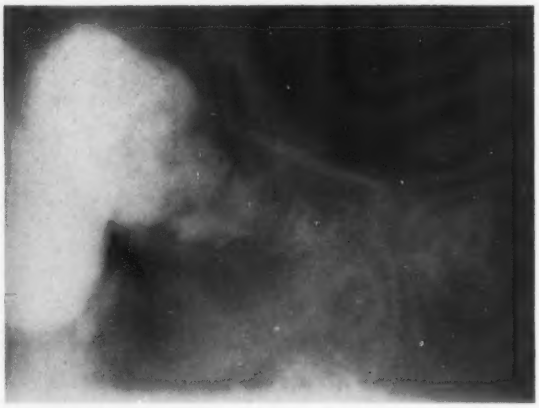

Fig. 5. Case III. A barium enema study revealed almost complete obstruction in the mid-sigmoid, and a sinus tract 5.0 cm. in length superior to the intestine drained into the markedly contracted lumen of the colon in a number of places. A smaller sinus tract drained and puddled into an abscess cavity to the left of the rectum. A few diverticula also filled.

area was an abscess cavity approximately 4.5 cm. in diameter. The patient was treated symptomatically with blood transfusions, antibiotics and a non-residue diet. His temperature rose to 101.8°F. on the fourth hospital day and gradually subsided. The attending physician stated that he could feel the mass in the left lower quadrant become smaller day by day. He was discharged six days later. Follow-up studies on this patient two months later revealed a bladder fistula and a colostomy was performed. This was followed by resection of the sigmoid four months after the second admission with an end-to-end anastomosis. He is now living and well almost four years since his first admission.

Case III (E.G.). This seventy-one year old white female was admitted to the hospital on November 30, 1953 because of epigastric pain, nausea and vomiting of three days' duration. She had had recent onset of constipation. She gave a past history of an abscess on the "stomach" one year previously which subsided under treatment.

Physical examination revealed a distended abdomen with generalized, mild tenderness and rebound phenomenon. Because of the distention, no masses were palpable. Two days after admission a barium enema study demonstrated diverticula, an abscess, and a fistulous tract in the sigmoid area (Fig. 5). She was treated symptomatically for eleven days and discharged as improved. She returned for another barium enema study two months later and prior to this examination she had had a colostomy performed (Fig. 6). The previously observed sinus tract could not be demonstrated although there was marked shortening of the sigmoid from numerous diverticula.

Case IV (N.W.). This fifty-nine year old white male was admitted to the hospital on May 17, 1954 because of blood in the stools. For several weeks prior to admission he had pain in the abdomen and back, and the pain had now become constant in the left lower quadrant. He gave a history of recent increasing constipation. Twenty-four hours prior to hospitalization he stated that he had passed about a quart of red blood by rectum.

Physical examination revealed a slightly tender, fixed mass in the left lower quadrant. A barium enema examination (Fig. 7) demonstrated innumerable diverticula and a fistulous tract 5.0 cm. in length on the superior aspect of

Fig. 6. Case III. Two months later following a colostomy, the sinus tract did not fill and there was a marked change in the appearance of the lumen of the sigmoid.

the sigmoid. His treatment was conservative and he was discharged eight days after admission. He returned for another barium enema study after one month of therapy and this revealed identical findings. He was personally contacted in July, 1957 and was asymptomatic.

Case v (J.M.). This eighty-six year old white female was admitted to the hospital on February 22, 1956 because of an abdominal mass. She had noticed increasing constipation and burning on urination during the past year. Several months prior to admission she began to notice discomfort in her left lower abdomen. Her physician had recently discovered a mass in the left lower quadrant of the abdomen.

Physical examination revealed a large, tender mass in the left lower quadrant of the abdomen. A barium enema study (Fig. 8) disclosed a large filling defect at least 6.0 cm. in length with several widely spaced tracts with

Fig. 7. Case iv. Barium enema examination demonstrated numerous diverticula in the sigmoid and descending colon with reduction in size of the lumen. A sinus tract 5.0 cm. in length above the sigmoid communicated with the lumen at several points. Another barium study approximately one month later showed no change in the roentgenographic appearance. Impression: Diverticulitis with abscess and intramural fistula.

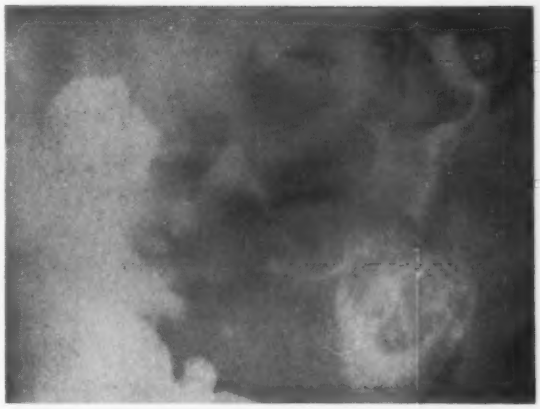

Fig. 8. Case v. Barium enema study revealed a large filling defect about 6.0 cm. in length practically occluding the sigmoid. Barium passed through two very narrow and widely separated tracts and these were the only communicating channels with the descending colon. No normal mucosa could be identified at the site of the defect and the roentgenographic impression was that of probably carcinoma with perforation and abscess formation. Several diverticula were identified in the lower descending colon. Pathologic diagnosis: Diverticulitis with abscess formation and fistulous tract

no identifiable mucosa connecting the sigmoid and descending colon. Seven days after admission the sigmoid was resected and a hard, irregular mass was removed. The pathologic specimen showed a hard, irregular mass with omentum adherent to it and composed of hard necrotizing fat. In the center of the mass a sigmoid stricture of approximately 1.0 cm. in diameter was demonstrated and a perforated area measuring 1.5 cm. in diameter led superiorly. Another irregular, tubular tract, measuring 5.0 cm. in length communicated with an abscess cavity and the colon inferiorly. Other portions of the abscess cavity could not be identified. Because of the fistulous tract communication, barium had evidently passed from the sigmoid through the abscess to the descending colon. She was discharged one month later improved.

Case vi (M.G.). This fifty-nine year old white male was admitted to Garfield Memorial Hospital on August 14, 1957 because of abdominal pain of five days' duration. He had been using laxatives because of chronic constipation.

Physical examination revealed abdominal distention and tenderness in the left lower quadrant. A barium enema study (Fig. 9) demonstrated a filling defect 3.0 cm. in length in the

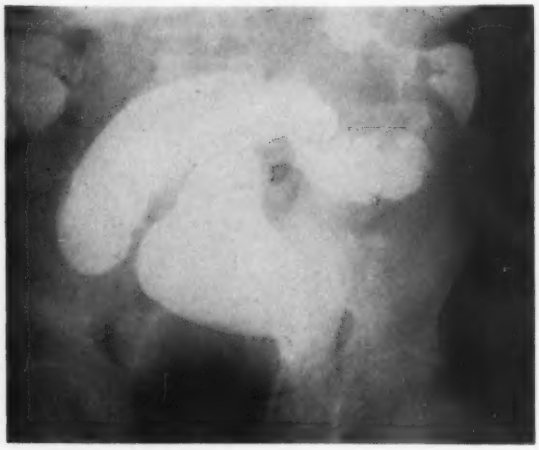

Fig. 9. Case vi. An annular filling defect was demonstrated in the descending colon. Below the lesion was a sinus tract. A number of diverticula were demonstrated in the sigmoid and descending colon.

lower descending colon resembling a carcinoma. Below the filling defect and medial to the colon was a fistulous tract 5.0 cm. in length which appeared to communicate with the lumen of the colon at a number of points. Many diverticula were also demonstrated in the colon. On August 26, 1956 the descending colon was resected at the George Washington University Hospital. The gross specimen (Fig. 10) revealed the wall of the colon to be thickened and indurated, averaging 2.5 cm. in width. The mucosa was somewhat edematous and scattered over the mucosal surface were the stomas of numerous diverticula. Near the distal end of the specimen was a fistulous tract 9.0 cm. in length which recommunicated with the bowel lumen through a second fistulous opening near the proximal edge

Fig. 10. Section of gross specimen showing the subserosal fistulous tract. Note the marked thickening of the muscularis.

of the resection; this tract averaged 0.5 cm. in diameter and dissected beyond the muscle layer and the subserosal fat. This was the tract that was filled with barium during the enema examination and which also filled when the specimen was injected (Fig. 11). A second similar 8.0 cm. long fistulous tract, traversing the submucosa, was found in the proximal segment of the bowel but this tract was not demonstrated at the time of the barium enema examination nor in the resected specimen. The final microscopic diagnosis was diverticulitis with two colocolic fistulae and diverticulosis.

Case vii (D.A.). This forty-six year old white male was admitted to the hospital July 2, 1950 because of an abscess and a mass in the left lower abdomen. He had been well until two weeks prior to admission when he experienced severe pain in the lower abdomen, and he had

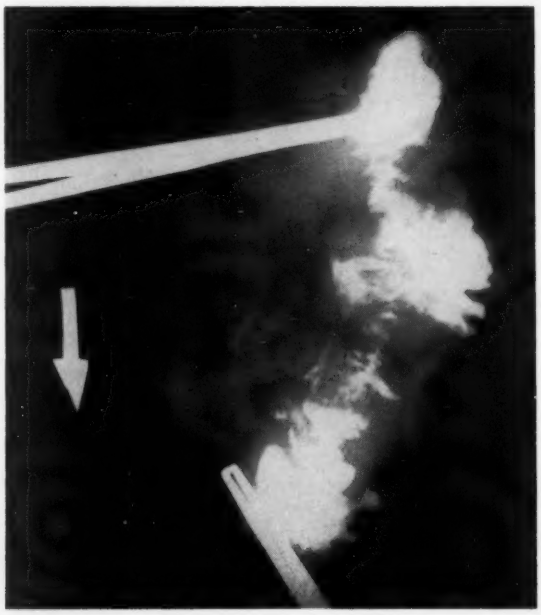

Fig. 11. Case vi. Diodrast was injected into the lumen of the operative specimen. Note that the sinus tract which filled when the barium enema was administered also filled with diodrast and communicated at a number of places with the lumen of the colon. This tract was carefully dissected and was entirely subserosal. A submucosal sinus tract was dissected out in the proximal half of the specimen but this tract did not fill either with barium or diodrast. Note also that the most proximal portion of the specimen which resembled carcinoma on the barium enema study, now definitely shows mucosal pattern and is due entirely to diverticulitis.

noticed increasing constipation and blood in his stools. Three days prior to admission a barium enema examination (Fig. 12) demonstrated a fistulous communication between the sigmoid colon and the small bowel.

Physical examination revealed tenderness in the left lower quadrant and a 7.0 cm. mass. He was treated with sulfathaladine and penicillin. A small bowel enema study, seven days after admission, revealed closure of the fistulous tract with only an adherent loop at the site of the previous abscess and fistula. He was discharged after two weeks of conservative therapy.

Case VIII (S.C.). This fifty-eight year old white male was admitted to the hospital on October 18, 1956 with the complaint of severe crampy pain in the abdomen of three days' duration. He gave a history of previous attacks of abdominal pain and it was known that he had diverticulosis. He also had been hospitalized elsewhere for four weeks prior to the present admission because of a perforated diverticulum and roentgenographic findings (Fig. 13) which demonstrated an ileocolic fistula.

Physical examination revealed abdominal distention and because of this no mass could be palpated. Conservative therapy was undertaken for twelve days and then a resection of the sigmoid colon and ileum at the ileocolic fistula was performed. An abscess was also encountered. The patient's postoperative course was remarkably uneventful considering his debility and the extent of the surgery. He was discharged as improved after a three week hospital stay.

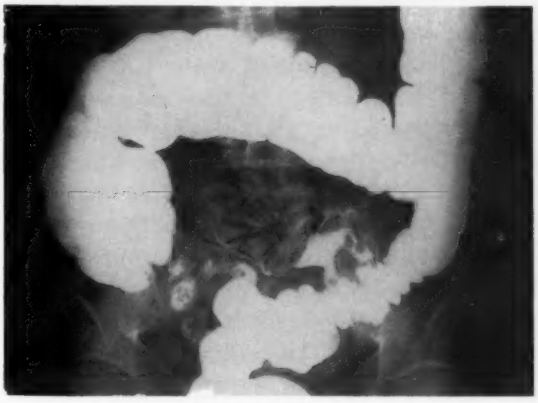

Fig. 12. Case VII. A fistulous communication between the sigmoid colon and small bowel was demonstrated. Several minute diverticula also filled in the sigmoid.

Fig. 13. Case VIII. Barium enema study revealed numerous diverticula in a markedly shortened and narrowed sigmoid. Barium was seen to pass from the sigmoid into a large dilated loop of ileum, lying directly above and from there, the barium passed readily into distal loops of ileum.

CLINICAL FINDINGS

The patients in this series were predominantly in the older age group and the ages ranged from forty-six to eighty-six years, the average being sixty-seven years; all were of the white race and there were 5 males and 3 females. Two patients were admitted with the diagnosis of intestinal obstruction, 2 with rectal bleeding, 1 with questionable peptic ulcer, and 1 with an abdominal mass, probably a neoplasm of the sigmoid. Two were admitted with a known diagnosis of ileocolic fistula on the basis of previous roentgenographic studies. Increasing constipation and abdominal pain were constant complaints of all of the patients. Nausea and vomiting were present in 5 patients and in 4 this was accom-

panied by abdominal distention. In the 4 patients who had no abdominal distention, tender masses were found, while in the patients with distention such masses could not be felt, evidently because of the distention. All the patients had a low-grade fever ranging up to 101.8°F. at some time during their hospital stay but there was no significant rise in temperature following barium enema study. The white blood cell count ranged from 14,800 to 21,400 and 6 of the patients had a moderate anemia. Three of the 8 patients gave a past history of diverticulosis or diverticulitis.

ROENTGEN FINDINGS

Numerous diverticula were demonstrated in every patient with associated spasm and tenderness. Evidence of chronic disease, characterized by a distorted, shortened colon with the wall thrown into numerous folds bunched closely together, producing limited contraction and expansion, was present in all patients. Mucosa was demonstrated to be present in the bowel adjacent to the abscesses and fistulous tracts in every patient with the exception of 2 which simulated carcinomatous filling defects. The fistulae varied from 5.0 cm. to 14.0 cm. in length and 0.2 cm. to 0.6 cm. in width. The entero-intestinal fistulae filled while barium enemas were being administered and in one of these patients a follow-up small bowel enema study demonstrated that the fistulous tract had closed under conservative therapy.

TREATMENT

In 2 patients conservative therapy was applied, and evidently due to the drainage of the abscesses they were able to return home improved. In another patient a cecostomy was performed followed later by a colostomy. A colostomy was done on 2 other patients and of the 3 who had colostomies, sigmoid resection was done in only 1 instance. Two patients had primary sigmoid resections. The sigmoid and ileum were resected and the ileocolic fistula removed in 1 patient. The prompt treatment of acute episodes of diverticulitis or prophylactic surgical resection of a chronically infected segment of intestine will prevent the occurrence of fistulous tracts.

DISCUSSION

Although a history of chronic symptoms could be obtained from only 3 patients, there was roentgenologic evidence that chronic disease was present in all the patients. Each inflammatory episode apparently leaves its scar on the colon which is eventually characterized by marked thickening of the muscularis and mucosa with reduction in size of its lumen. Inflammatory and necrotic areas may develop in the submucosa, muscularis, and the serosa, which become smoldering points for recurrent acute episodes. The inflammatory reaction may extend into the fat surrounding the intestine and into the mesentery, producing large masses of fat necrosis and fibrosis. It would also appear that it is possible for fistulous tracts to drain the abscess into the leaf of the mesentery or the pericolic fat prior to entering the inflamed bowel at other areas. When internal or external drainage of these abscesses is not possible, intramural fistulous tracts sometimes form, emptying the contents of the abscess at distant multiple points into the lumen of the intestine.

Wolf and co-workers[12] illustrated the unusual parallel barium tracts and assumed that one was the lumen of the colon and the other an artificial lumen in the submucosa, re-entering the lumen of the colon at some distance from the original abscess. In the single satisfactory surgical specimen in this series (Case VI), careful dissection has shown that two artificial tracts may be formed, one submucosal and one subserosal. In this case the subserosal artificial tract was the larger and the only one demonstrated at the time of the barium enema examination. The structure of diverticula with their poorly supported, bulbous, extramuscular portion would suggest that most of the colocolic fistulae were subserosal rather than submucosal. A study

of the roentgenograms in some of the cases of Wolf and his co-workers[12] suggests that in 3 of their cases the sinus tract could also be subserosal. In the subserosal type, with the fistula outside the muscularis, an important restraining barrier is lost and this may lead to further perforation outside the wall of the colon and other abscesses and fistulous tracts may form. It is suggested that further observation and investigation of such cases be done. It is postulated that once the diagnosis of such fistulae is made, prompt surgical intervention may be indicated to prevent further complications.

The serosal or extraserosal inflammatory reaction causes pericolic adhesions to form and adjacent loops of small bowel may become adherent. If abscesses form near such adhesive processes, then enterointestinal communication may be established.

Filling of these fistulous tracts with barium has proved that drainage of the abscess exists and when this occurs the patient's clinical course may improve. The evidence at hand indicates that there is no contraindication to a barium enema examination when such sinus tracts are present.

SUMMARY

1. Eight cases with fistulous tracts as the result of diverticulitis and abscess formation communicating either with the colon or small intestine have been presented.

2. Six patients had colocolic fistulae varying from 5.0 to 14.0 cm. in length, paralleling the lumen of the intestine. These fistulae re-entered the lumen of the colon in a number of places some distance from the original abscess. These tracts may be either subserosal or submucosal and this is determined by the distance they lie above the lumen of the colon.

3. Once the diagnosis of an intramural fistulous tract is made, prompt surgical intervention may prevent further complications.

4. Two patients had fistulae communicating between the colon and the small bowel. This type of fistula is thought to be the result of pericolic adhesions binding adjacent loops of small bowel, and when an abscess perforates beyond the wall of the colon, then entrance is made into the small intestine.

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The author wishes to thank Dr. Theodore Winship, Garfield Memorial Hospital, for his assistance; Dr. Thomas Peery and Dr. William Newman, George Washington University Hospital, for their cooperation and pathologic study of one of the cases.

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HAZARDS OF INTESTINAL INTUBATION*

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ALTHOUGH all physicians have had some experience with intestinal intubation, patients presenting complications associated with this procedure are seen infrequently. Recently, a patient was observed with the unusual complication of intestinal obstruction due to absorption of gas in the balloon of a Harris tube. The findings were a surprise to both radiologists and surgeons and are, therefore, the subject of this report.

Harris and Gordon[3] reported 7 instances in which the balloon of a gastrointestinal tube entered the cecum, thus necessitating the cutting of the tube to permit its passage. Twenty-four hours to ten days were required for passage. In 3 of these patients, the difficulty in removing the tube was thought to be due to gas in the balloon. Operative intervention was necessary in 1 patient, and in all of the 3, the tube had been in the bowel more than ten days. In a study of 5,000 instances of gastrointestinal intubation, Cantor[1] noted that the time required to pass a swallowed tube was usually four to eighteen days. One patient retained the balloon, which had separated from the tube, for a period of twenty-nine days. In Cantor's[2] series of cases, the complication of absorption of gas into the balloon at the distal end of the tube was 0.3 per cent, and in the majority of these cases the accumulation of air was in insignificant amounts. Moore and his associates[6] reported a patient with complete obstruction of the bowel above adhesions by the distended balloon at the end of a Cantor tube.

Other complications of intestinal intubation have been reported in the literature; these are classified by Lichtenstein[5] as follows:

I. Mechanical
  A. Balloon
    1. Rupture. 2. Overdistention.
  B. Tube
    1. Leaking. 2. Kinking or knotting. 3. Occlusion.
  C. Adapters
    1. Inaccurate fit. 2. Error due to labeling.

II. Anatomic
  A. Respiratory tract
    1. Edema of the turbinates. 2. Epistaxis. 3. Sinusitis. 4. Eustachian tube inflammation. 5. Otitis media. 6. Laryngeal edema. 7. Pneumonitis.
  B. Gastrointestinal tract
    1. Pharyngitis. 2. Esophageal erosion and stricture. 3. Gastric erosion, perforation and hemorrhage. 4. Intestinal erosion, perforation and hemorrhage. 5. Intussusception.

REPORT OF A CASE

A seventy year old white male was admitted on July 18, 1956 with a three months' history of dysphagia. On the day prior to admission the patient underwent esophagoscopy. This revealed an indurated, friable, granular, ulcerating lesion located 25 cm. below the incisors, measuring 4 to 6 cm. in length. Histologic examination of the biopsy specimen was interpreted as squamous cell carcinoma of the esophagus.

On July 21, 1956 resection of the distal esophageal lesion and primary end-to-side anastomosis with the gastric fundus within the thorax were performed. A Heller pyloroplasty was also done at this time. Histologic examination of the surgical specimen revealed tumor at the resection site with lymph node involvement and infiltration through all layers of the esophageal wall.

Because of the patient's difficulty in retaining food postoperatively, intubation and feeding through the tube were performed. On August 9, a fluoroscopic examination while the patient swallowed barium revealed almost com-

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plete obstruction of the pylorus at the hiatus of the diaphragm, with obstruction to the passage of the tube and the barium. Subsequently, the tube passed and on August 12 was noted at the ligament of Treitz. By August 18 the tube had been removed and the patient could eat a semi-soft diet. He was discharged on August 19, at which time his regurgitation was minimal.

The patient was re-admitted on August 27 with a four day history of persistent emesis and sensation of obstruction in the retrosternal area. On August 30, surgical exploration with manual dilatation of the pylorus and passage of the nasogastric tube were accomplished. Soon after surgery the patient removed the tube, which was replaced with a Harris tube on September 3. On September 5, because of respiratory difficulty, a tracheotomy was performed. On September 7 the patient developed abdominal distention, and on September 8 he became stuporous. An attempt to remove the tube was unsuccessful. A roentgenogram of the abdomen revealed the tip of the tube in the right lower quadrant with a small amount of gas in the balloon at the distal end (Fig. 1). On September 10 the tube was severed about two feet above the distal end and a string was tied to the proximal end. Tube and string were allowed to pass into the gastrointestinal tract. By September 18 several feet of the string had passed into the gastrointestinal tract, but the remaining portion of the tube remained in the same position in the right lower quadrant. On

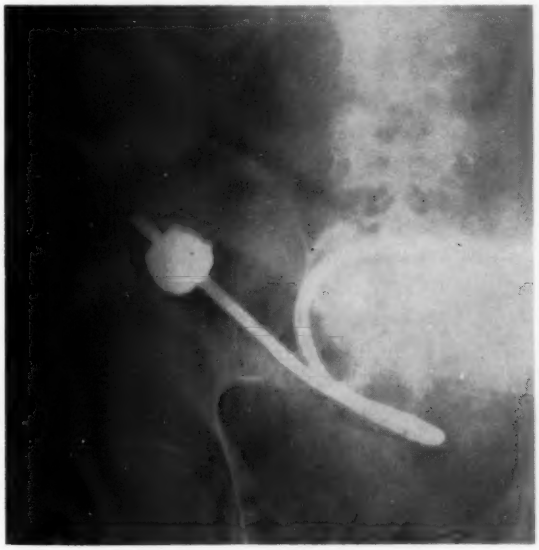

Fig. 1. September 9, 1956. Small amount of gas in the balloon of a Harris tube.

Fig. 2. September 19, 1956. Balloon outlined by arrows. Dilated loops of small intestine.

September 19 small bowel dilatation above the distal end of the tube was noted and the balloon appeared more distended (Fig. 2). On September 24 the balloon was more dilated than in the previous film and hyperactive bowel sounds were heard (Fig. 3). On September 27 cramping abdominal pain and tenderness were noted. A roentgenogram taken on September 29 revealed no change in the position of the tube and persistent dilatation of the balloon at the distal end.

On September 29 exploratory laparotomy was performed. There was angulation of the bowel due to adhesions 2 feet from the ileocecal valve. Immediately above this area the balloon was found containing approximately 80 cc. of gas; this was aspirated, and the tube was removed by enterostomy. It was noted that the obstruction was incomplete, since material could still pass through the tube from above the obstruction to below the obstruction. Subsequently, the patient developed a suppurative wound infection which drained feces, but at present the wound is healed and the patient is doing moderately well.

DISCUSSION

The three tubes in common use are the Miller-Abbott, the Cantor, and the Harris tubes. If gas accumulates in the balloon of a Miller-Abbott tube it can be aspirated

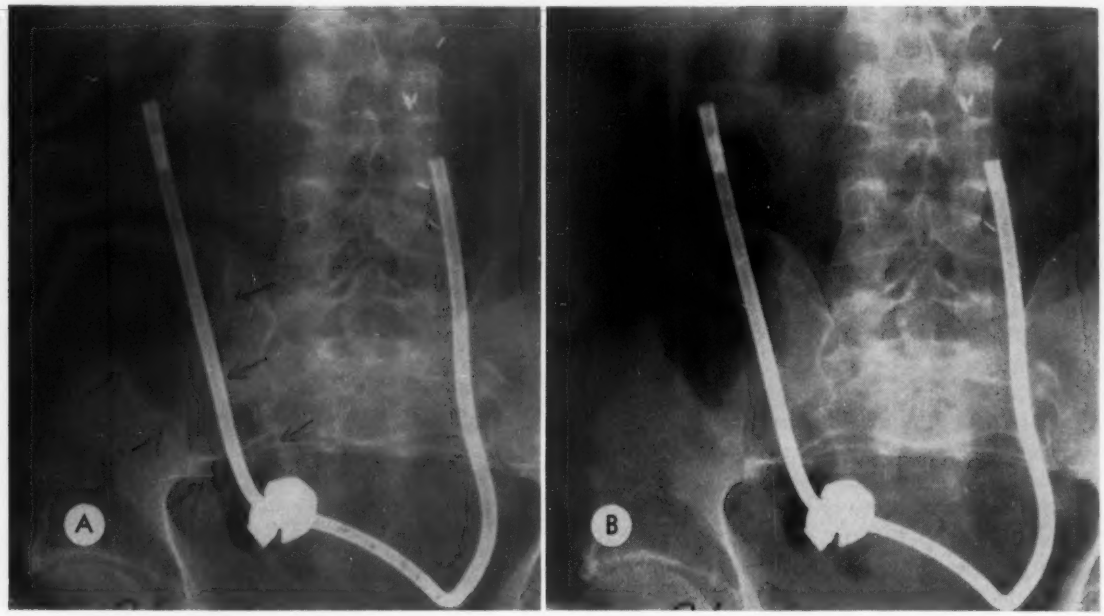

FIG. 3. September 24, 1956. (*A* and *B*) Balloon with approximately the same amount of gas as in Figure 2. Decreased small bowel distention, five days before laparotomy.

from the distal end of the tube, unless the tube is kinked or knotted; but in the Cantor and Harris tubes, gas which is absorbed cannot be aspirated.

Much work has been done to determine the chemical constituents of the gas in the intestine. The average values are noted by Cantor[2] as follows: nitrogen, 70–80 per cent; oxygen, 1–10 per cent; carbon dioxide, 4–18 per cent; hydrogen, 1–6 per cent; and hydrogen sulfide, 2–12 per cent.

Hydrogen sulfide is the gas most readily diffusible, passing rapidly in and out of the intestinal tube balloon. The balloon of a gastrointestinal tube is highly permeable to carbon dioxide. The balloon is least permeable to nitrogen.

It has been noted in the reported cases of this complication that the carbon dioxide content of the gas in the balloon is abnormally high. It is believed that the etiology is based primarily on the law of partial pressure of gases and that the diffusion of carbon dioxide from the obstructed intestine into the balloon takes place because of the difference in carbon dioxide content within the balloon and within the intestine. The ingress of gas into the balloon takes place until the pressures are equal on both sides of the semipermeable membrane.

Phelps, Cantor and Esling[7] performed interesting experimental studies relating to the diffusion of gases into balloons and demonstrated that the diffusion into the balloon of the Cantor tube as compared to the Miller-Abbott or to the Harris tube is appreciably different. These authors felt that the reasons for this disparity are: (1) the difference in the thickness of the rubber balloon used, (2) the difference in the surface area exposed to the gas, and (3) the law of partial pressure of gases. The thickness of the wall of the Miller-Abbott balloon and of the Harris balloon is 0.06 mm., whereas the thickness of the wall of the Cantor balloon ranges from 0.24 mm. in its midportion to 0.40 mm. at its base and neck. The balloon of the Harris tube is ordinarily 6 inches long as compared to the balloons of the Miller-Abbott and Cantor tubes, which are approximately 2½ inches long. Thus, the surface area of the balloon in the Harris tube is more than twice that of the Miller-Abbott or Cantor balloons and can contain as much as 125 cc. of gas when distended. Phelps, Cantor and Esling also found that Neoprene G. balloons were far less permeable to carbon dioxide under all

conditions than latex balloons; the Neoprene G. balloons were noted to be only 19 per cent as permeable to carbon dioxide as latex rubber. The balloon of the Cantor tube is made of Neoprene G. material, and the composition of the balloon of the Harris tube is of approximately 97 per cent rubber from natural Hevea latex and 3 per cent compounding materials.

Lewis and Leff[4] found experimentally that a balloon perfused with carbon dioxide and suspended in a carbon dioxide external atmosphere absorbed no appreciable amount of the gas. However, when the balloon was not flushed with carbon dioxide and was suspended in a carbon dioxide surrounding, it became distended and tense within one day.

CONCLUSIONS

In order to overcome the complication of intestinal obstruction, Harris and Gordon[3] and Cantor[2] suggest that the balloons be flushed with carbon dioxide prior to use. The suggestion of Cantor is that a No. 21 or No. 22 needle be placed next to the rubber balloon under the tie when the tie is applied to the tube. The small orifice that remains when the needle is removed permits egress and ingress of gas, but not mercury.

Ordinarily, despite the amount of gas within the balloon, the balloon would be expected to pass per rectum unless a complete or partial obstruction is present. The cases that have been reported previously and the present case record narrowing or kinking of the bowel due to adhesions distal to the dilated balloon, with obstruction above this area.

SUMMARY

This is a case report and a discussion of an unusual complication of gastrointestinal intubation. Intestinal obstruction has occurred with all types of tubes which use a balloon at the distal end. The dynamics involved and a suggested method of prevention are described.

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This patient was referred to our department through the courtesy of Dr. H. Brodie Stephens.

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A SPECIAL PROCEDURE FOR COMBINED SURVEY OF THE WHOLE GASTROINTESTINAL TRACT INCLUDING THE APPENDAGES*

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THE roentgenologic exploration of the esophagus, stomach and colon has lately been perfected to such a degree that it is now possible to detect practically all diseases of these organs. Difficulties are still encountered, however, as regards the methods concerning examination of the small intestine, as well as the regular diagnosis of chronic appendicitis.

So far, examination of the small intestine, *i.e.*, the longest section of the gastrointestinal canal and the greatest organ of absorption, has been handicapped owing to purely technical reasons. The procedure often requires several hours, and the busy physician may find it impracticable. This explains, perhaps, why the search for tumors of the small intestine, for instance, is so unsatisfactory; indeed, with the aid of the common barium preparations, only a small percentage of cases and a very restricted portion of the bowel can be visualized each time. A general survey of the small bowel, with or without intensifying screens, fails because of the time involved, the constant need of control roentgenograms, the cost and the strain on the roentgenologic service, and because transitory pathologic conditions that can be visualized only for a very short time may pass unnoticed on the roentgenogram. Actual improvement may be expected by speeding up the intestinal passage. Many attempts have been made at stimulating and accelerating not only gastric peristalsis but also the motility of the small bowel. To mention some, physiologic saline or ice water has been added to the barium meal, or morphine, prostigmine, ipecacuanha, and insulin have been administered. A less known method is that of Foti who claims to be able to readily detect a duodenal lesion by adding 40 gm. of butter to the barium solution.

The ileocecal region has not received sufficient attention from the roentgenologists, for important conditions that are on the borderline of pathology as, for example, the lymph node enlargement of children and adults, have only recently been correctly diagnosed. Here again, the delay involved in visualizing this area is of undeniable practical significance.

Evidently, study of the appendix must form part of any gastrointestinal survey. Detection of a retrocecally situated appendix, or an adhering vermiform process, might at once explain some obscure clinical condition. Its exploration, however, is technically handicapped chiefly because it rarely fills either by the oral or the rectal route. Moreover, the adding of magnesium sulfate to the barium meal is not always successful, and is infrequently used in routine work. There is no contrast medium available at the present time which could ensure a high proportion of filled appendices, *i.e.*, such a proportion that a negative filling could be regarded as pathognomonic.

Another difficulty of gastroenterologic roentgen exploration concerns the early recognition of disturbances located in the critical abdominal angle, *i.e.*, in the right hypochondrium, where it is hard to determine whether the duodenum, the right colon flexure, or the gallbladder is involved.

In view of the lack of a suitable contrast medium for expediently surveying the whole gastrointestinal canal and also the gallbladder, the writer devised a simple procedure which would accomplish such a purpose. This procedure permits survey of the esophagus, stomach and duodenum in the usual manner, and, within reasonable limits of time, examination of the small intestine down to the ileocecal region. The appendix fills in a surprisingly high per-

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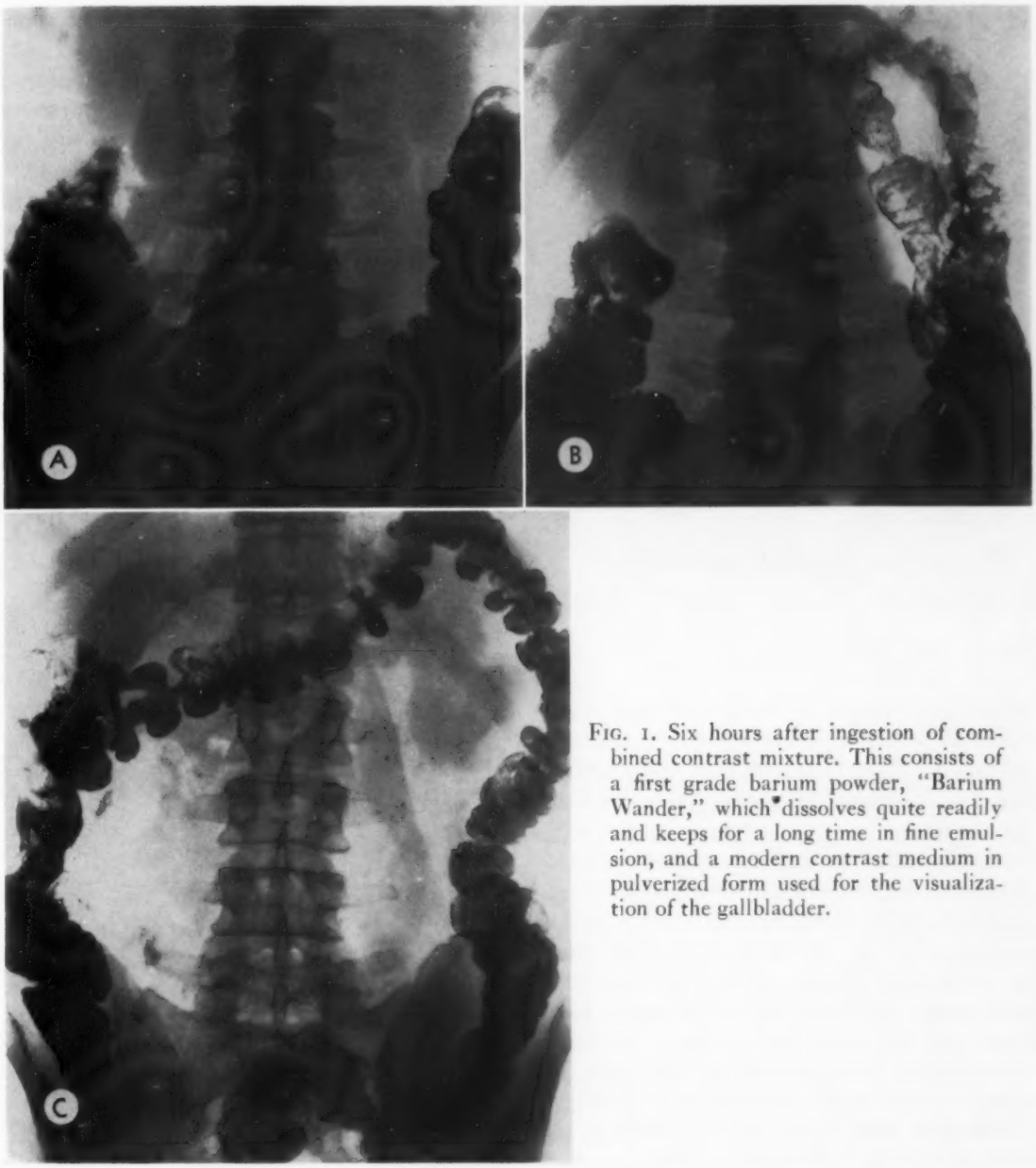

Fig. 1. Six hours after ingestion of combined contrast mixture. This consists of a first grade barium powder, "Barium Wander," which dissolves quite readily and keeps for a long time in fine emulsion, and a modern contrast medium in pulverized form used for the visualization of the gallbladder.

centage of cases and, since the contrast medium is still rather fluid when entering the large bowel, it opacifies the whole colon including its descending portion. Within six hours, even the gallbladder can be visualized.

The contrast mixture used in this procedure has the following composition: As a basic substance, first grade barium powder must be employed, not just the common pure barium sulfate. In Europe, we use "Barium Wander" which dissolves quite readily and keeps for a long time in fine emulsion. This product is then mixed with a convenient modern contrast medium for visualization of the gallbladder. The tablets of the medium are pulverized, or prepared in a liquid form and added to the barium suspension. We have tested several commercial gallbladder media such as biliselectan, telepaque, and priodax in various dosages, and have found that 4.5 gm. of active

FIG. 2. Six hours after ingestion of combined contrast mixture. Gallbladder deformed due to pericholecystic adhesions.

principle+125 gm. of Barium Wander is an optimal ratio. This mixture of pulverized tablets and Barium Wander, dispersed in the usual manner in water, produces some foam and settles a little faster; consequently, it should always be prepared fresh for each patient. Sensitive patients may complain of slight irritation of the throat and of a somewhat bitter taste, but this could readily be overcome by some improved gallbladder contrast medium made available in a finely pulverized form. Appraisal of this disadvantage should also take into account that, at the present, in some special methods of examination of the small bowel, products which are more unpleasant to taste are being used.

The advantages of this combined contrast procedure are considerable. The esophagus, stomach and duodenum are surveyed in the usual manner. In those instances in which sensitive patients complain about the bitter taste of the mixture, a small amount of the ordinary barium suspension is administered first. Unfortunately, experience shows that these patients also take the plain meal with some aversion. Therefore, the above mentioned organs are explored with the usual technique and methods; only then is the mixture given. One is greatly surprised to find in how short a time, mostly within the first half hour after beginning of the fluoroscopic survey, does the entire small intestine visualize. Owing to hypermotility, the small intestine fills even more uniformly than with a fractionated method of examination. The hypermotility also promptly reveals rigidities in the intestinal wall. With some experience one is able to recognize a common enteritis or a helminthiasis.

When gastrointestinal examinations are performed on several patients one after another, the small bowel and the ileocecal region can be studied after a short period.

FIG. 3. Six hours after ingestion of combined contrast mixture. Filling of appendix.

In other words, a patient may be surveyed from the esophagus to the ileocecal region within the first half hour.

Six hours after starting the fluoroscopy a full roentgenographic survey is made, which, in most cases, shows uniform filling of the entire colon, including its lowest segments. Because of the accelerated passage, the contrast mixture is still relatively fluid and the colon contains no lumps, as occurs with the usual contrast media that make proper diagnosis in the descending intestinal segments practically impossible. The roentgen appearance is similar to that seen following barium enema study. By this time, a number of patients have already eliminated some of the contrast mixture. Unlike former contrast media, the present mixture never entails constipation. Due to the hypermotility of the bowels, rumbling in the abdomen is occasionally noted, but we have never observed other untoward reactions.

Fig. 5. Thirty minutes after ingestion of combined contrast mixture.

Fig. 4. Six hours after ingestion of combined contrast mixture. Filling of gallbladder and of appendix.

On the roentgenograms taken six hours after ingestion of the contrast mixture, the gallbladder is also visualized in an extraordinarily high percentage of cases. We have been surprised to find, in a series of 88 patients, that the gallbladder had remained unfilled in only 5 cases, and was partly filled in 4; consequently, the proportion of filled gallbladders has been very satisfacfactory. While the contrasting shadow is not as dark as that cast by modern contrast media, we do not consider this to be a disadvantage. Recently, it has been found that small concretions may easily be overlooked on roentgenograms in which the contrast is too intense.

With the combined filling of the gallbladder and bulbus duodeni, we know from previous experience that the overcasting shadow of the duodenum can become quite disturbing for the exploration of the gall-

FIG. 6. Thirty minutes after ingestion of combined contrast mixture. Ascaris to the right of L5.

bladder. In this respect, the above mentioned filling method with simultaneous visualization of the right colon flexure does not interfere as much, since the gallbladder can be freely projected by rotating the patient. Besides, with this method it is possible to fill the bulbus duodeni separately by giving an ordinary barium suspension. Thus it is possible to make a full survey of the duodenum, gallbladder and colon flexure in their mutual relationships.

The questions, why the gallbladder is completely filled after six hours, and why this occurs in a high percentage of cases, are answered by the investigations of Italian authors. These observers have noted some time ago that filling is much more satisfactory with ordinary gallbladder preparations when a relatively large amount of water is drunk by the patient at the time he takes the contrast medium. Even in cases where the gallbladder has not been filled—and this occurs quite often with the use of the current oral methods—one can force the visualization by having the patient swallow some water. In the above described combined procedure, the administration of the contrast medium for the gallbladder together with the relatively large amount of barium suspension (125 cc. of barium in 500 cc. of water) has the same effect as drinking water, and this explains why the gallbladder is seen so often and so distinctly. Tests designed to add the gallbladder contrast medium to a barium enema have not been continued because the practical applications of this type of examination are different.

The combined contrast procedure has also been used on a limited scale for mass survey. A serial investigation of this kind was made in 29 persons believed to have a healthy gastrointestinal canal and a normal gallbladder. Gallstones were found in 4 subjects who were unaware of their condition. This incidence seems to be high, but it is in keeping with the percentage of cases with gallstones found at necropsy. Moreover, the six-hour roentgenograms also revealed an almost constant filling of the appendix. Thus, we have been able to fill both normal and diseased appendices in healthy subjects. This organ visualized in a proportion never seen before. Roentgenograms showed filling in practically all of the 29 persons who still had their appendix, regardless whether the appendix was normal or diseased. This kind of roentgenologic survey of the appendix seems extraordinarily advantageous to us, in fact as advantageous as that of the gallbladder which is achieved with the same contrast mixture.

It may be asked whether both gallbladder and gastrointestinal canal could be visualized by examining the gastrointestinal tract in the usual manner, while the gallbladder is filled by the intravenous route. This would immediately bring up a second question: When should the intravenous injection be done? If the injection is made prior to starting the examination of the stomach, the patient might experience discomfort when the stomach is completely filled with the barium meal. The danger of

the intravenous method and a possible accident must also be taken into account. A second roentgenogram must then be made two hours after ingestion of the barium meal. This additional roentgenogram becomes unnecessary with the above mentioned combined procedure. The main advantage of this procedure, however, is that one can survey the small bowel, the ileocecal region and the appendix, including even the descending colon. Thus, with two surveys, the first involving the esophagus, stomach, small bowel and ileocecum, and the second at six hours, the whole colon, gallbladder and appendix, considerable territory is covered—a fact which renders this procedure particularly suitable for mass studies.

SUMMARY

A description is given of a simple procedure, providing a means of surveying within six hours the whole gastrointestinal canal, with special consideration of the small bowel, the ileocecal region, the descending colon and, in a high percentage of cases, the gallbladder and the appendix as well. The procedure is suited both for individual clinical examinations and for mass surveys. The saving of films is another important factor.

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ROKITANSKY-ASCHOFF SINUSES IN THE GALLBLADDER

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RECENTLY Culver, Berens and Bean[2] reviewed the literature related to the visualization of Rokitansky-Aschoff sinuses in the gallbladder by means of oral cholecystography. They noted a high incidence of stenosis associated with the pathologic finding, adding 5 new cases to those previously reported.

The writers wish to record 3 additional cases examined in the Department of Radiology of Touro Infirmary confirming the findings of Culver and co-workers[2] and of Friedman and Skorneck,[3] as regards the presence of stenosis in the neck of the gallbladder associated with Rokitansky-Aschoff sinuses.

REPORT OF CASES

Case I. WM, aged thirty-five, was admitted on March 9, 1956 with a history of sharp upper abdominal pain after meals for the previous three years. There was no significant qualitative dyspepsia, although at times milk seemed to aggravate the pain, which was described as radiating to the back. There was no anorexia or constipation, but there was some weight loss three to four weeks prior to admission amounting to about 10 pounds.

The physical examination was essentially negative, except for a mild epigastric tenderness on deep palpation.

The routine laboratory findings were negative or within normal limits including a complete blood count, urinalysis, Kolmer Wassermann and VDRL tests.

Roentgen Findings. Cholecystography performed on January 23, 1956 prior to admission revealed good visualization of the gallbladder fifteen hours after the oral administration of telepaque tablets. The borders of the gallbladder appeared fuzzy with fine irregular bristle-like projections; there was a rather marked and abrupt narrowing of the neck of the gallbladder. No calculi were demonstrable. In view of the findings, and although the patient did not take a fatty meal during the examination, the presence of Rokitansky-Aschoff sinuses was suspected and a diagnosis of chronic cholecystitis was made (Fig. 1).

Operative Findings. On March 10, 1956 a cholecystectomy with choledocostomy and insertion of a T-tube was performed. The gallbladder appeared to be partially intrahepatic and chronically inflamed. The wall of the gallbladder was considerably thickened and fibrotic. Upon opening the gallbladder a small amount of thick bile was found in the fundus and the mucosa appeared grossly nodular.

Surgical Pathology. The gallbladder measured 8.5 cm. in length and approximately 4 cm. in its greatest diameter. The outer surface was grayish green in color. The wall averaged 1.5 cm. in thickness, the mucosa was somewhat uneven and greenish amber in color, and in the distal portion it exhibited several bright yellow flecks.

Microscopic examination revealed the presence of multiple diverticula or sinuses, marked fibrosis in the wall with lymphocytic infiltration indicating long standing chronic inflammation.

Case II. WF, aged forty-one, was admitted on October 3, 1954 with a diagnosis of chronic cholecystitis and exacerbation of symptoms for the previous three or four months. There was no history of previous jaundice, although on several occasions the patient noted light colored stools.

The physical examination was essentially negative.

Routine laboratory findings revealed a slight pyuria; all other procedures including cephalin flocculation, serology, bilirubin, alkaline phosphatase, bromsulphalein, prothrombin time, glucose, nonprotein nitrogen, and a complete blood count were within normal limits.

Roentgen Findings. Oral cholecystography with telepaque tablets revealed good visualization of the gallbladder at the end of fifteen hours. Several large radiolucent shadows were

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contained in the gallbladder indicating the presence of calculi. A sharp constriction was noted in the proximal portion of the neck of the gallbladder. Small portions of the contrast medium seemed to form a halo around the fundus; this halo was more sharply outlined after the administration of the fatty meal. The collection of contrast medium in the form of a halo around the fundus of the gallbladder was interpreted as indicative of the presence of Rokitansky-Aschoff sinuses and a diagnosis of chronic cholecystitis with cholelithiasis was made (Fig. 2).

Operative Findings. On October 11, 1954 a cholecystectomy was performed. The gallbladder was found to contain several calculi, but it was not opened in the operating room.

Surgical Pathology. The gallbladder measured 9 cm. in length and 3 cm. in its greatest diameter. It was partially covered by a smooth pink serosa. When opened, it was found to contain a thick greenish-brown bile and 4 stones, the largest of which was 2 cm. in diameter. The wall of the gallbladder was thickened, measuring up to .7 cm. The mucosa appeared coarse and fibrous.

Fig. 1. Case I. Cholecystogram showing stenosis at the neck of the gallbladder as well as fuzziness and fading of the outline of the fundus of the gallbladder.

Fig. 2. Case II. Cholecystogram showing the gallbladder calculi, stenosis at the neck, and the halo effect of the contrast medium around the fundus of the gallbladder.

Microscopic examination revealed the presence of rather large submucosal sinuses or diverticula associated with considerable fibrosis and round cell infiltration. In several of the sinuses microscopic calculi were present along with inspissated bile plugs.

Case III. WF, aged twenty-two, was admitted on May 7, 1957 with a two year history of recurrent epigastric pain, weakness, and anorexia. The patient stated that she lost about 20 pounds of weight during the last two years. She was told by a local physician that she had intestinal worms. The pain was not relieved by foods, although it occasionally subsided following vomiting.

The physical examination showed a poorly nourished female who weighed about 99 pounds. The other significant finding was a small mass in the left parametrium on pelvic examination.

Routine laboratory studies demonstrated the presence of Necator americanus ova and

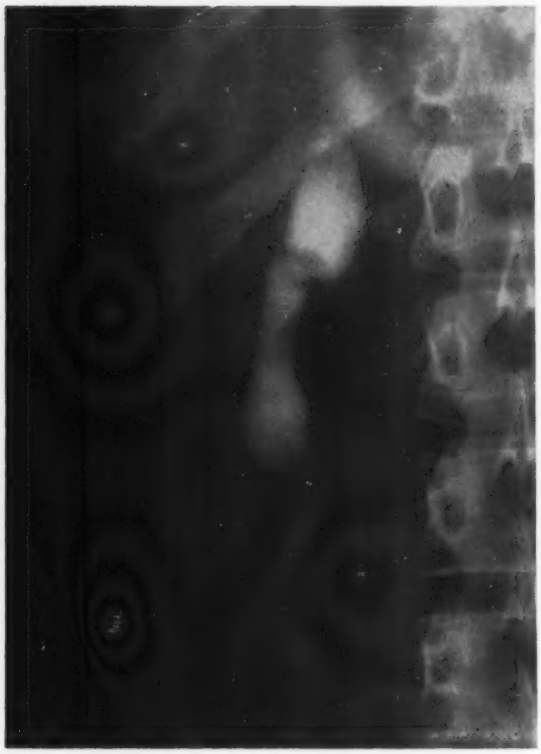

FIG. 3. Case III. Cholecystogram showing the constrictions of the distal and proximal portions of the neck, and fuzziness and irregularity of the outline of the fundus of the gallbladder.

Strongyloides larvae in the stool; there was a mild microcytic anemia. Serology gave positive Kolmer and negative VDRL tests.

Roentgen Findings. Oral cholecystography with telepaque tablets revealed good visualization of the gallbladder fifteen hours after the administration of the contrast medium. The outline of the fundus was rather fuzzy, with irregular, fine, bristle-like projections of contrast medium. A sharp constriction was noted near the proximal portion of the neck of the gallbladder. No calculi were seen and there was a slight contraction of the gallbladder shadow following the fat stimulus. A diagnosis of chronic cholecystitis was made, suggested by the presence of Rokitansky-Aschoff sinuses (Fig. 3).

As yet, an operation has not been performed.

DISCUSSION

Similar to the observations of Culver *et al.*[2] and Friedman and Skorneck,[3] there was a sharp constriction or stenosis of the neck of the gallbladder in our cases where the sinuses were noted. In the cases reported by Ackerman,[1] Glücker,[4] Lawler,[6] and King,[5] there was no mention of the presence of stenosis in the gallbladder. Some authors propose that intracystic increase of pressure in the gallbladder leads to the formation of sinuses or diverticula, and, in those cases in which no stenosis is demonstrable, another aspect in the pathophysiology of the gallbladder function may enter into the formation of these sinuses; namely, intermittent spasm at the neck or cystic duct as discussed by Strelinger[9] in his article on biliary dyssynergia. This author found that patients who have demonstrable Rokitansky-Aschoff sinuses by cholecystography are relieved of their symptoms by cholecystectomy, whereas those patients with chronic cholecystitis without stones and without evidence of dyskinesia are generally not benefited by cholecystectomy.

Le Quesne and Ranger[7] described the basic histopathology of Rokitansky-Aschoff sinuses as the formation of epithelial sinuses which penetrate through the muscular layer in the gallbladder wall and expand in the perimuscular or subserous layer. They also described an associated muscular hypertrophy, chronic inflammatory changes and intramural calculus formation. According to them there are three characteristic roentgenologic features in the demonstration of Rokitansky-Aschoff sinuses: (1) filling defects at the fundus, sometimes presenting a central pit; (2) a stricture in the body or in the region of the fundus; (3) spaces filled with contrast medium around the periphery of a considerable portion of the gallbladder.

Stalker, Davies, and Guest,[8] and Friedman and Skorneck[3] state that the roentgenographic visualization of Rokitansky-Aschoff sinuses is an indication for cholecystectomy in a patient with symptomatic chronic gallbladder disease.

It is our belief that the visualization of these sinsuses by cholecystography signifies a rather severe chronic gallbladder disease and in the presence of symptoms referable

to the gallbladder, cholecystectomy should be strongly considered. In this respect, and as regards the management of chronic biliary disease, the radiologist can be of great aid both to the internist and the surgeon. The gross and microscopic findings in the surgical specimens which exhibited these sinuses roentgenographically point to a rather marked thickening and fibrosis of the gallbladder wall, with evidence of bile stasis and formation of small calculi in the so-called diverticula.

SUMMARY

Three cases of chronic gallbladder disease showing Rokitansky-Aschoff sinuses are reported.

The histopathology underlying these sinuses is discussed.

The opinion is expressed that the presence of Rokitansky-Aschoff sinuses, as demonstrated by cholecystography, is indicative of severe gallbladder disease and cholecystectomy should be considered.

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EVALUATION OF A NEW COLON EVACUANT: DIHYDROXYPHENYLISATIN

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THE well cleansed colon and effective barium enema study remain goals rather than consistent achievements. We were attracted by reports on dihydroxyphenylisatin, a nonabsorbable chemical, which stimulates colonic evacuation by direct action on the musosa.[5] This substance is known as veripaque (Bayer Products, Ltd.) in Great Britain and was generously supplied in this country by Winthrop Laboratories under the trade name "Lavema."*

We have tried lavema in cleansing and barium enemas on a total of 162 adult patients (Table 1).

COLLOIDAL BARIUM ENEMA AND LAVEMA

McLaren *et al.*[3] mix veripaque and water with micropaque (Damancy & Co., Ltd.), a proprietary barium sulfate preparation with colloidal properties due to its small particle size. They administer their solution through 7/16 inch bore tubing and a No. 22 English gauge rectal tube. The diameter is important since, with their method, the patient remains on the roentgenographic table and evacuates through the same tube; too small a lumen slows evacuation and the examination fails. They feel that evacuation gives a more dynamic concept of the diseased state and have come to depend more upon observation of evacuation than filling.

While it is indeed intriguing to watch peristalsis without the usual worry of having barium scattered about the room, our examination of 35 patients has not convinced us that this procedure represents a real improvement in the routine examination of the colon. Perhaps it will ultimately prove advantageous in certain conditions, just as the double contrast enema is used when polyps are sought. Evaluation of potential advantages must be balanced against the following disadvantages:

1. The procedure is more time consuming for both the radiologist and technical staff. If one fluoroscopes during the "fill-up," takes overhead tube roentgenograms, then fluoroscopes during evacuation and takes more roentgenograms, the usual number of changes from roentgenography to fluoroscopy is doubled.

2. Evacuation is frequently a slow process and the fluoroscopic exposure time is thereby increased.

3. In the event of a prolonged evacuation time or delay of even a few minutes in taking the evacuation roentgenograms, the mucosal detail is lost (Fig. 1).

4. If the patient is not well prepared, the tube may become clogged during emptying. In such instances conventional evacuation invariably results in poor mucosal detail on subsequent roentgenograms.

5. Usually the rectum, and frequently the sigmoid, will not empty through the tube (Fig. 1*A*). While radiologists do not feel overly responsible for the easily accessible rectum, visualization of the sigmoid mucosal pattern should not be routinely abandoned.

6. Colloidal barium preparations are relatively expensive and ordinary barium sulfate will not yield good mucosal detail with this method.

LAVEMA IN CONVENTIONAL BARIUM ENEMAS

It was initially hoped that lavema might be more effective than tannic acid in con-

* Each vial contained, in powder form, 40 mg. of the active chemical mixed with inert ingredients to a total of 3 gm. These inert substances were cocoa oil soap, sequestrene disodium salt, and lactose.[6]

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TABLE I

SUMMARY OF DIHYDROXYPHENYLISATIN ADMINISTRATION

Administered in:	Mg./L.	Water	No. of Patients	Patient Discomfort (o–++++)	Remarks
Colloidal barium enema evacuated through large tube†	20	Distilled	35	o	Good mucosal detail if evacuated quickly through tube (see text)
Routine barium enema‡	20	Plain	20	+–++	Poor mucosal detail, expulsion very complete
		Distilled	9*	o–+	
	10	Plain	10	±–+	Incomplete emptying with clumping; poor mucosal detail in evacuated areas
	5	Plain	9	o–±	Considerable clumping
Cleansing enema	20	Plain	9	++–++++	Excellent cleansing
		Distilled	45	o–±	
	10	Plain	13	+–++	Good cleansing
		Distilled	7	o	
	5	Plain	5	±	Fair cleansing

* Group includes four enemas to which tannic acid was also added. These reactions were ++ – ++++. Mucosal detail improved somewhat.

† 250 grams barium per liter of water (w/v).

‡ 200 grams barium per liter of water (w/v).

ventional barium enemas with normal evacuation. As Table I indicates, the reverse was true. With 20 mg. per liter, emptying was excellent but mucosal detail was very poor, resembling quite closely the delayed evacuation roentgenograms when used with colloidal barium. With decreasing concentrations of lavema, evacuation became less complete while mucosal detail improved only slightly.

When tannic acid was added also, as suggested by Andrén *et al.*[1] the mucosal detail improved but patient discomfort increased markedly.

LAVEMA AS A CLEANSING ENEMA

It is as a cleansing enema that lavema has achieved its greatest effectiveness in our hands. The desirable concentration is 20 mg. of lavema per liter of distilled water, but 10 mg. per liter is only slightly less effective.

If the patient is able to tolerate it, 2 liters should be given at one time. This can usually be accomplished if one slows the flow when there is a complaint of fullness, and turns the patient on his right side after the first liter has been given. These are maneuvers commonly used during a barium enema examination, but are somehow neglected when administering cleansing enemas. The patient is not asked to hold the solution beyond the minute or two required to move from table to bathroom. No subsequent plain water washouts need be given.

Lavema has proved very effective in its cleansing action and causes no more discomfort than a plain water enema. It is rapid; the average time required, including

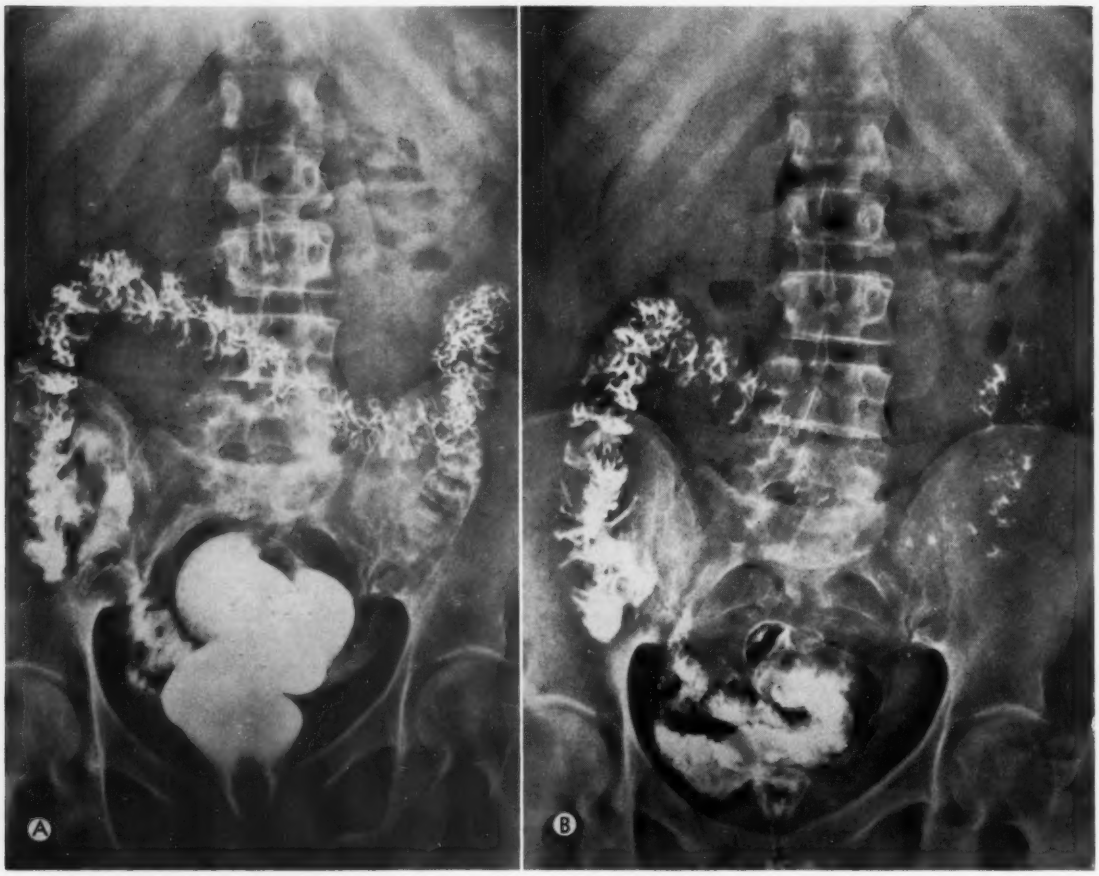

FIG. 1. Evacuation roentgenograms following colloidal barium-lavema enema. (*A*) Evacuation through wide bore tube. Note the excellent mucosal pattern and the frequently seen incomplete emptying of the rectum and distal sigmoid. (*B*) Taken three to four minutes later. With the tube removed the patient was given less than one minute to expel the remaining barium solution. Note the characteristic loss of mucosal detail, here seen from the midtransverse colon distalward but often involving the entire colon.

evacuation, was twenty-five to thirty minutes.

This method is *not* suitable for cleansing prior to barium enemas because the subsequent mucosal detail is poor even though no lavema has been added to the barium mixture itself; this was true with or without tannic acid in the barium solution. A three hour recovery interval between the cleansing enema and barium enema, as advocated by Copland,[2] did not improve our results.

Cleansing enemas with lavema are thus limited to preparation for intravenous pyelography and other abdominal studies, particularly when there is retained barium in the colon (Fig. 2).

PATIENT REACTION

In tap water, lavema causes cramping, nausea and vomiting. Both distilled water and barium sulfate, particularly in its colloidal form, markedly reduce patient discomfort. There is no ready explanation for the influence of tap water; perhaps the mineral content and/or pH play a part. Tap water has been used successfully[2,4] and probably should be tried in other sections of the country before one resorts to distilled water. Barium sulfate appears to exert a demulcent effect which is enhanced by the greater surface area available when the barium is in a more finely dispersed state.

It is of interest that the 2 patients who

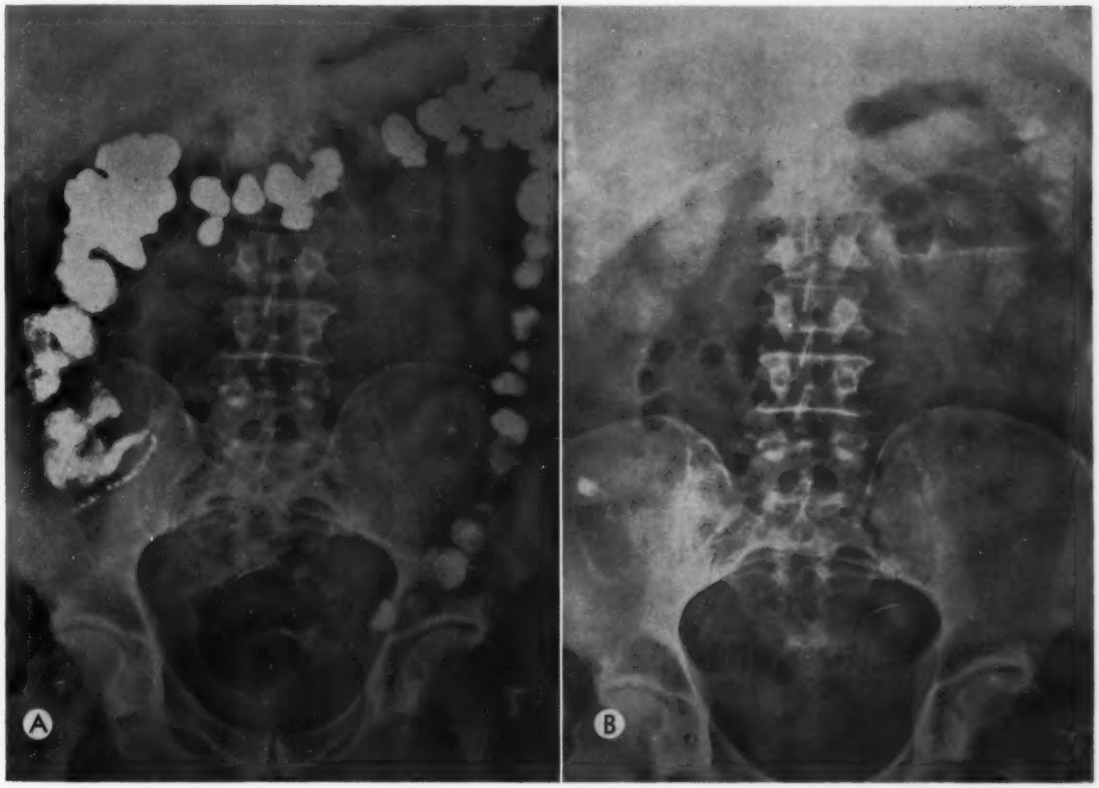

Fig. 2. (*A*) Plain roentgenogram of the abdomen twenty-four hours after barium examination of the upper gastrointestinal tract. (*B*) Roentgenogram following 2 liter cleansing enema of 20 mg. lavema per liter of distilled water. Usually the colon is entirely free of residue but this case was chosen because it illustrates that even the reluctant appendix has evacuated.

showed the least reaction to lavema tap water cleansing enemas had lesions which prevented filling of the ascending colon. One may speculate that either the right side of the colon is the more sensitive, or simply that a lesser volume was administered.

SUMMARY AND CONCLUSIONS

1. We have found lavema to be an effective, rapid, preparatory cleansing enema for roentgen examinations other than barium enema. It should be mixed in distilled water, 10 to 20 mg. per liter, and 2 liters administered.

2. Lavema is not a suitable substitute for, or addition to, tannic acid in routine barium enemas.

3. Lavema in colloidal barium sulfate solution administered and evacuated through a wide bore tube has too many disadvantages to warrant its wide application in studies of the colon.

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We wish to express our appreciation to B. Buice, R.T., B. Martin, R.N., C. Helms, R.T., M. K. Smith, R.T. and H. Holbrook, R.T. for their valuable assistance during the course of this study.

ADDENDUM

The lavema cleansing enemas have been put into routine use on several wards. In an additional 102 cases only one untoward incident occurred and we believe this was

due to the inadvertent use of tap, rather than distilled, water. Interestingly enough, when this patient was given a plain distilled water enema, the symptoms of marked cramping and nausea were immediately relieved.

The cleansing effect of the enemas has not been as uniformly satisfactory as when administered by personnel of the Department of Radiology. The distribution of the failures points to certain ward personnel and emphasizes the importance of reeducation to the method detailed here if lavema enemas are to be used successfully.

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Vol. 79, No. 5

DECUBITUS BOARD*

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IN SEVERAL publications of the last decade, the importance of taking roentgenograms in the lateral reclining position has been emphasized. We have found these lateral decubitus roentgenograms in double contrast study of the colon so valuable that they are taken routinely. Although the newest types of tilt tables permit rotation of the patient about the short axis of his body for 360 degrees, there is no tilt table or accessory to the tilt table available which enables rotation of the patient around the long axis of his body. This lack of a suitable tilt table makes satisfactory roentgenographic examination of the patient in left and right lateral decubitus difficult.

In most cases in which these examinations are necessary, a stretcher with the laterally reclining patient is placed in front of the vertical tilt table. This procedure permits the use of the Bucky diaphragm in the tilt table, but the connection of the stretcher with the tilt table and of the patient with the tilt table board is rather loose. The patient himself is in a very unstable position on the stretcher. By using another method, the patient lies on his side on the tilt table. Instead of the roentgen tube over the table, another roentgen tube, often of a mobile unit with a low power output, is used. No moving Bucky diaphragm except perhaps a stationary grid is employed and usually only an improvised cassette holder. Often the cassette is even held by hand.

With the aim of improving roentgenographic positioning for examination in the lateral decubitus, a device was constructed which permits rotation of the patient around the long axis of his body for study in any desired horizontal position. This device is called the "decubitus board." Its essentials are illustrated by means of drawings and photographs in the following figures:

Figure 1*A* is a drawing of the decubitus board in a perspective view as attached to a tilt table. Figure 1*B* is a top view of the board and Figure 1*C* a side view of the same. As may be seen, the board (10) is mounted on a metal frame (11, 12) consisting of angle profiles, either using iron or preferably light metal. The entire metal frame is welded together. The board, 18

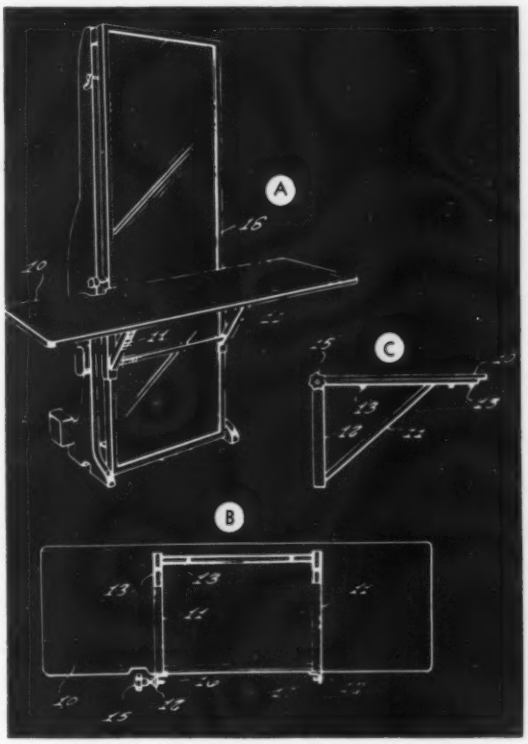

FIG. 1. Drawing of the decubitus board which is attached to a tilt table in a perspective view (*A*), a top view (*B*) and a side view (*C*). The board (10) is bolted to a metal frame (11, 12) as illustrated at (13). At the back end, the frame is provided with a handle (15) having a threaded shaft (16) and a bolt (17) which fit into holes in the frame (18) of the tilt table.

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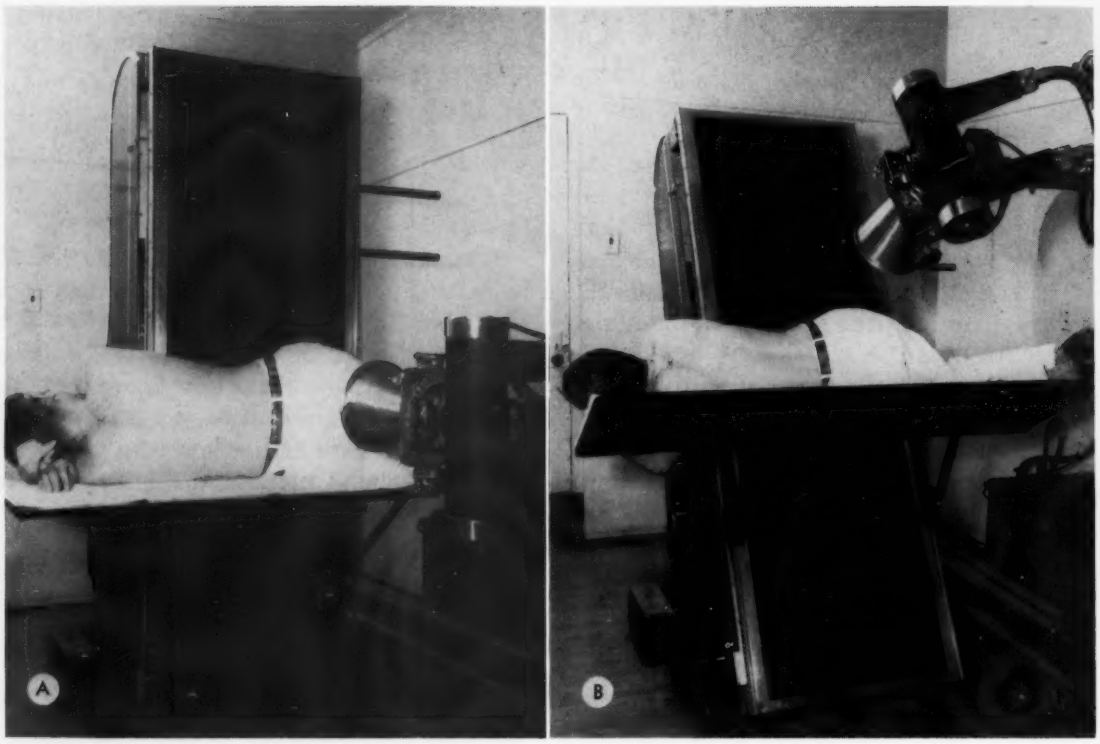

Fig. 2. (*A*) Photograph of the decubitus board on the vertical tilt table with a patient in left lateral decubitus. (*B*) The tilt table with the decubitus board and the patient is tilted backward.

inches by 60 inches, may consist of plywood or of composition wood or plastic. It is bolted to the metal frame as shown at (13). At the back end, the frame is provided with a handle having a threaded shaft (16) and a bolt (17) which fit into holes in the frame (18) of the tilt table. The board can be attached to the vertical tilt table at any height. The lowest position is only a few inches above the floor. In the lowest position even a very obese patient or a patient handicapped by a large plaster cast can place himself upon the board without help. A stretcher patient would need assistance.

Figure 2, *A* and *B* are photographs of the decubitus board with a patient, in two different positions. In *B* the tilt table is angulated backward a few degrees, and the patient is pressed against the board of the tilt table by gravity which provides a stable position and some compression. The illustrations show the patient in left lateral decubitus. For right lateral decubitus the patient has to lie on his right side, instead of on his left side as pictured. For translateral roentgenograms the tilt table is in a vertical position and the patient is either in supine or in prone position on the decubitus board. As seen in the photographs, a high-powered over the table roentgen tube and a Bucky diaphragm in the tilt table are used. If roentgenograms without the Bucky diaphragm, with or without a stationary grid, are preferred, these can be taken simply by placing the cassette with or without a stationary grid between the patient and the board of the tilt table. The firm position of the patient, grid and cassette is automatically provided by angulating the tilt table a few degrees backward.

Another construction of the decubitus board which has some additional advantages is shown in the drawing of Figure 3. Two additional boards (20 and 21) are provided, one at each end of the main board (10). These are so designed that they are perpendicular to the main board (10). They form a second platform with the tilt

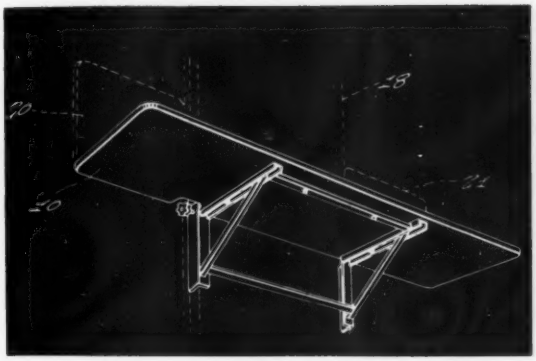

Fig. 3. Drawing of the decubitus board, showing two additional boards (20 and 21), one at each end of the main board (10). They form a second platform with the tilt table which is angulated between them.

table which angulates between them. Figure 4, *A* and *B* are photographs of this decubitus board attached to a tilt table in different positions.

The photographs of Figure 5, *A*, *B* and *C* show the decubitus board with a patient,

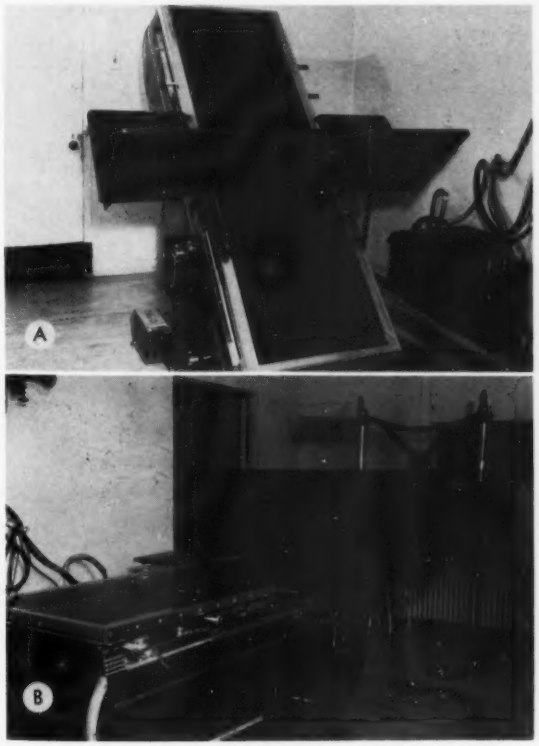

Fig. 4. (*A* and *B*) photographs of the decubitus board, as drawn in Figure 3, showing attachment to the tilt table in backward angulated and horizontal positions, respectively.

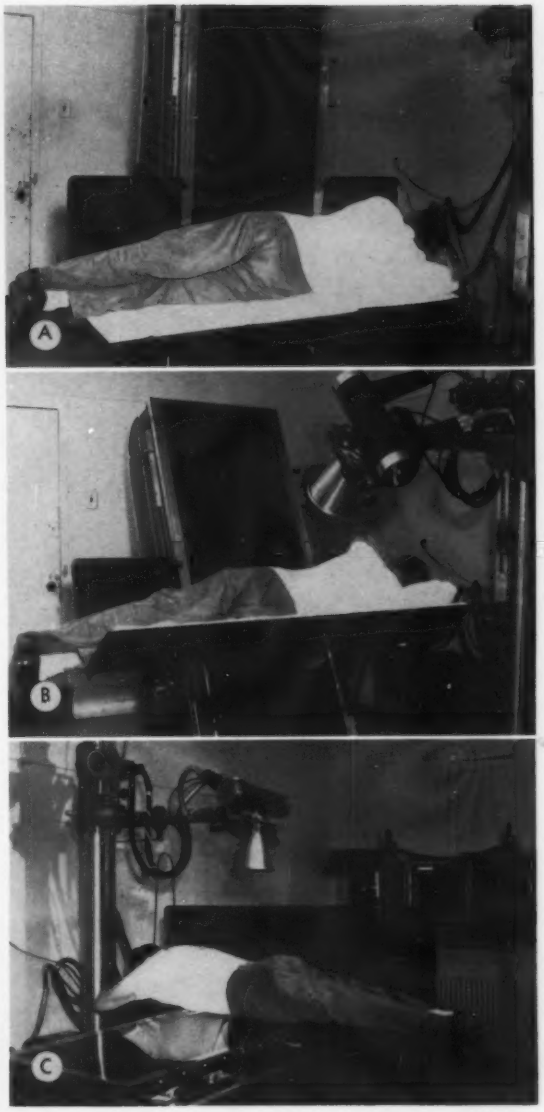

Fig. 5. (*A*, *B* and *C*). Photographs of the decubitus board, as drawn in Figure 3, showing attachment to the tilt table in vertical, backward angulated and horizontal positions, with a patient.

in different positions, starting with the right lateral decubitus (*A*), ending with the prone position (*C*) and including one intermediary position (*B*). These photographs illustrate how easily the change of position is acomplished by tilting the table from the vertical to the horizontal position. For further rotation use of straps on the decubitus board or of a compression band is advisable.

Preferably the two additional boards (20 and 21) are attached to the main board

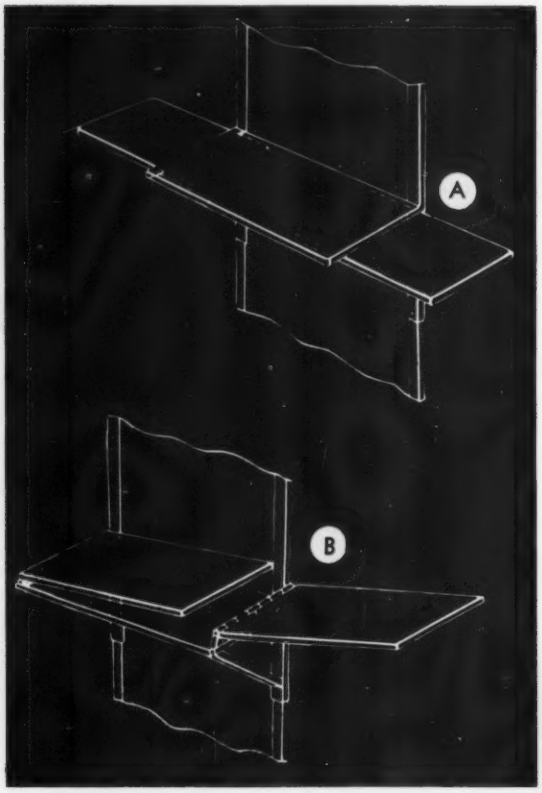

Fig. 6. A modification of the decubitus board as drawn in Figure 1. The length of the board is the same as the width of the tilt table. To extend the decubitus board to the desired length two extension boards can be pulled out from under the board (*A*) or two additional boards can be unfolded (*B*).

(10), as shown in Figure 3, not by angle irons but with hinges. This makes the decubitus board less bulky and easier to remove and to attach, by folding the additional boards (20 and 21) flat on the main board (10).

In the above mentioned arrangement the decubitus board has to be removed from the tilt table when the latter is used for other examinations. This is no problem since the decubitus board is very light if built of light materials. Even so, it may be sometimes desirable to shorten its length to equal the width of the tilt table. Then it can either remain permanently on the tilt table or it may be stored in a small space.

This feature is shown in the drawings of Figure 6 and 7. Here, the length of the main decubitus board is the same as the width of the tilt table. By extending or unfolding additional boards the desired length can easily be obtained.

As indicated above, the lateral decubitus board is an accessory to present tilt tables; however, it could be constructed as a permanent and integral part of any tilt table.

SUMMARY

A decubitus board has been described which has the function of facilitating and improving roentgenographic examination of the horizontally lying patient in any position which can be attained by rotation around the long axis of his body.

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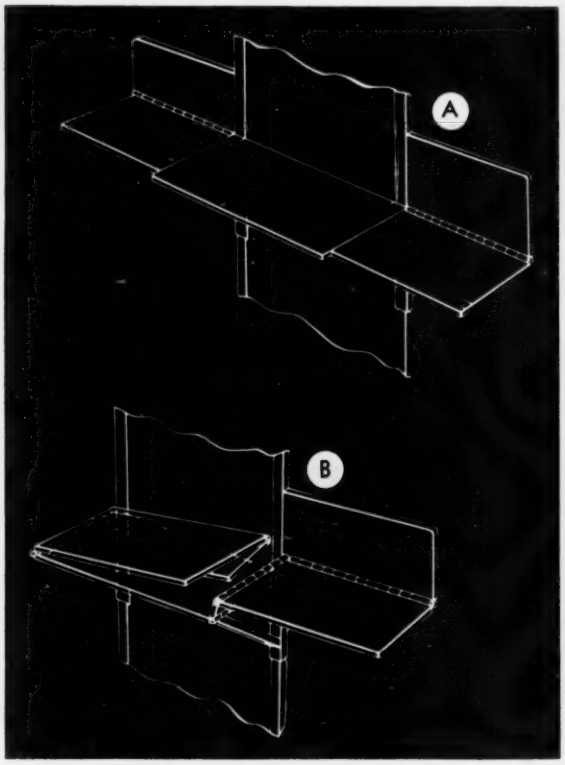

Fig. 7. A modification of the decubitus board as drawn in Figure 3. The length of the board is the same as the width of the tilt table. The desired length of the decubitus board and of the second platform can be obtained by pulling out (*A*) or unfolding four additional boards (*B*).

AN IMPROVED LOGETRONIC METHOD OF COPYING ROENTGENOGRAMS

By DAVID M. GOULD, M.D.,* *and* BOB L. WALLOCH†
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THE task of obtaining a faithful copy of a roentgenogram on paper is indeed a challenge. A roentgenographic film viewed by transmitted light has a very great range of density (of the order of 1–1,000). A paper print viewed by reflected light has a very short range of density (of the order of 1–50). It is practically impossible by conventional methods to transfer the long range of roentgenographic film to the short range of photographic paper. The conventional paper print telescopes or blocks most of the high densities as well as most of the low densities. Only the mid-range of densities is retained and the information originally present in the extremes is lost (Fig. 1).

With the LogEtronic printer it is possible to obtain copies of roentgenograms, both paper prints and transparencies, far superior to those made by conventional methods.[3] The LogEtronic photographic copying apparatus is basically a contact printer using a scanning light spot which is generated by a cathode tube.[1,2] The inherent value of the LogEtronic printer is its ability to dodge electronically each change of density of the film. Where a film has low density the feedback circuit decreases the light and where the film has high density, the light output is increased. By this automatic device, the density extremes of the roentgenographic film are proportionally compressed to fit the short range of the paper.

There is, however, one undesirable phenomenon which occurs when certain roentgenograms are copied with the LogEtronic printer. Areas which should appear white, such as bone and barium, appear gray on the reproduction (Fig. 2).

Our method of overcoming this "graying effect" makes use of a special emulsion found in Gevaert CO 23 (Correctone) film. This film has a "built-in highlight mask" which makes it possible to bring back the original density of the thin or highlight areas, without affecting the mid-range and high density areas. This film has a fusion of two separate emulsions. One emulsion has the low gamma, long scale for continuous tone reproduction and is sensitive to blue light. The other emulsion has high gamma and high contrast and is sensitive only to yellow light. The film is exposed twice. In the first exposure, the blue sensitive portion of the emulsion is exposed in the usual manner with the LogEtronic printer. In the second exposure, the yellow sensitive emulsion is exposed to an auxil-

FIG. 1. Conventional contact print of a roentgenogram showing barium in the colon after evacuation.

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Fig. 2. Ordinary LogEtronic print of the same roentgenogram as in Figure 1.

Fig. 3. Improved LogEtronic copy of the same roentgenogram as in Figure 1 using Gevaert CO 23 (Correctone) film.

iary yellow light. A yellow light is used because the LogEtronic printing light source is deficient in yellow. This flashed, nondodged, yellow light exposure builds up density on the intermediate where highlights of very low density areas exist on the original. The density build-up in the intermediate brings back the highlight areas in the final copy (Fig. 3).

The auxiliary light source is made in the following manner (Fig. 4). A seven inch, circular, cold, orange-yellow neon tube is placed around the projection lens of the printer. A small step-up transformer is attached parallel to the circular tube. A 20 watt, 1,500 ohm resistor is placed in series with the primary stage of the transformer. The time is governed by an electrical interval timer.

The settings of the LogEtronic printer for the exposures of the intermediate print are given in Table 1. These settings are given only as a rough guide since they will vary with each LogEtronic printer and with the type of reproduction desired.

The intermediate Correctone film is developed in conventional roentgen solutions for four minutes at 68° either in a hand tank or automatic Pako machine.

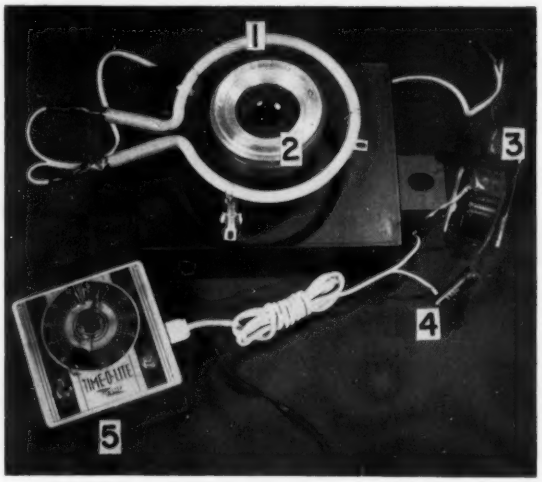

Fig. 4. Assembly of auxiliary light source: 1, seven inch neon tube; 2, LogEtronic lens; 3, transformer; 4, 1,500 ohm resistor; 5, electronic timer.

Table I

FACTORS FOR THE INTERMEDIATE FILM

LogEtronic Control	Position of Control
1. Multiplier	×1
2. Exposure index	70
3. Frequency	1 second
4. Exposure spot position	Area of Average Density
5. Lens aperture	4
6. Dodging factor	4
7. Interval timer (second exposure)	3 seconds

The factors used in producing a final paper print as illustrated in Figure 3 are given in Table II.

The remaining settings are the same as for the intermediate. The paper print is developed in Eastman Kodak Dektol diluted one part developer to two parts of water and developed approximately for two minutes at 68 degrees. Inspection development in a tray can help control density and contrast.

Table II

PAPER PRINT (EASTMAN KODAK MEDALIST F-2 PAPER)

LogEtronic Control	Position of Control
1. Multiplier	×10
2. Exposure index	50
3. Lens aperture	1 (max. opening)
4. Dodging factor	0–4 (depending on contrast desired)

SUMMARY

An improved LogEtronic method of copying roentgenograms makes use of Gevaert CO 23 (Correctone) film as the intermediate. It has the virtue of eliminating the undesirable graying effect which occurs when copying low density areas with the LogEtronic apparatus.

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2. Craig, D. R. LogEtronics. *Photogrammetric Engineering*, 1955, *6*, 556–564.
3. St. John, E. G., and Craig, D. R. LogEtronography. Am. J. Roentgenol., Rad. Therapy & Nuclear Med., 1957, *78*, 124–133.

"SPOT" PHOTOFLUOROGRAPHY WITH IMAGE INTENSIFIER AND NEW POLAROID PROJECTION FILM*

APPLICATION FORESHADOWING IMMEDIATE REPORTING AND MINIATURIZATION, DUPLICATION AND PROJECTION OF ROENTGEN FILM RECORDS WITH REDUCTION IN RADIATION EXPOSURE

By HERBERT M. STAUFFER, M.D., ARCHIE W. BLACKSTONE, E.E., *and* EDWARD E. CHRISTENSEN, M.D.
PHILADELPHIA, PENNSYLVANIA

AMONG the outstanding technical problems confronting diagnostic radiology today, particularly in larger institutions, are:

1. Frequent separation of the radiologist from the patient being examined and from the actual conduct of the radiologic diagnostic procedure.
2. Minimizing radiation exposure.
3. The high initial cost of full size conventional roentgen film and the labor, space, equipment and material required for processing.
4. Delay in obtaining film records and diagnostic opinions.
5. Film filing and storage.

The development of new electronic devices for handling the roentgenographic image and of new photographic techniques is the key to the solution of many of these problems.

This presentation illustrates one such approach that is easily accomplished with available electronic equipment and photographic material. The output phosphor of a Phillips electronic image intensifier is

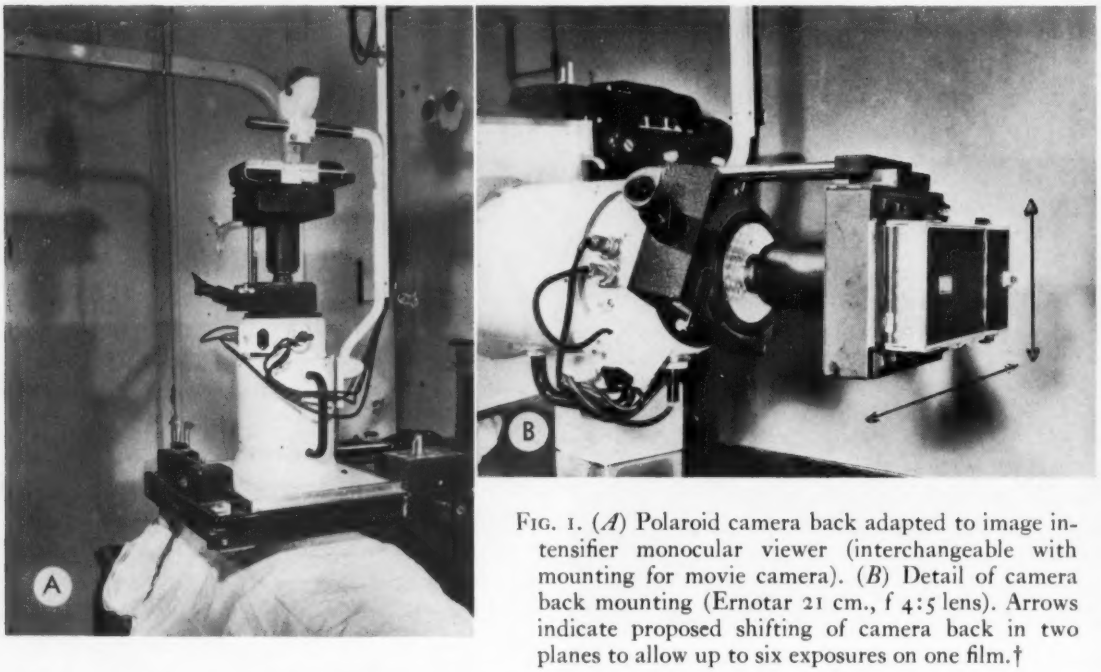

FIG. 1. (*A*) Polaroid camera back adapted to image intensifier monocular viewer (interchangeable with mounting for movie camera). (*B*) Detail of camera back mounting (Ernotar 21 cm., f 4:5 lens). Arrows indicate proposed shifting of camera back in two planes to allow up to six exposures on one film.†

* From the Department of Radiology, Temple University School of Medicine and Hospital, Philadelphia, Pennsylvania.
Aided by Grant #CS-9438 (Field Investigation), National Cancer Institute, United States Public Health Service.
† For information regarding camera adaptation address Fairchild Camera and Instrument Corporation, Syosset, New York.

photographed on the new Polaroid-Land projection film (Type 46-L) which has a speed (ASA exposure index equivalent) of 1,000 daylight and 700 tungsten. (Trial of the standard Polaroid paper material in this application has been reported previously.[1] This proved too slow for practical use.)

Figure 1 shows the adaptation of the Polaroid camera back to the Phillips image intensifier. If an 8 inch lens is employed with the camera back, an image approximately 2 inches in diameter is obtained. This is approximately four times the diameter of the Phillips intensifier output phosphor and almost one-half the diameter of the original input phosphor image. Thus the resulting image on the Polaroid projection film frame ($3\frac{1}{4}\times 4$ inches) is perfectly adequate for direct viewing and it can also be projected readily.

By photographing the intensifier phosphor with a lens of 4 inch focal length, an image approximately 1 inch in diameter is obtained. Serial shifting of the position of the camera back relative to the lens will

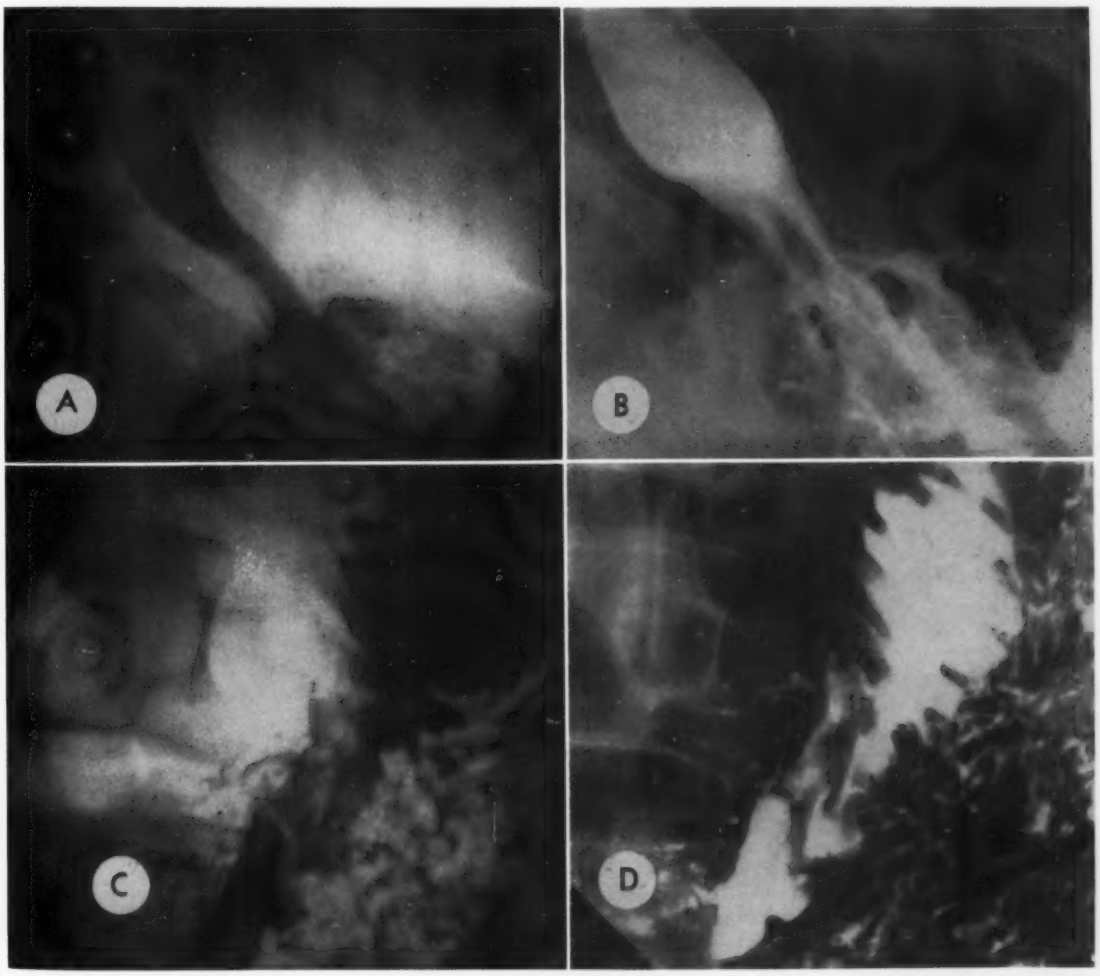

Fig. 2. Comparison of conventional "spot" roentgenograms and Polaroid projection film photofluorograms of adult patients made on filming fluoroscope. Exposure time was the only factor varied. (*A*) Polaroid photofluorogram of esophagogastric junction; 90 kv., 100 ma., 0.1 sec. (*B*) Conventional "spot" roentgenogram of same subject; 0.1 sec. (Eastman Blue Brand film; Par-speed screens). (*C*) Polaroid photofluorogram of abdomen (small bowel); 85 kv., 100 ma., 0.25 sec. (*D*) Conventional "spot" roentgenogram of same subject; 0.4 sec.

make it possible to obtain up to six "spot" photofluorograms on a single $3\frac{1}{4}\times4$ inch Polaroid film frame which can then be immediately processed and viewed within two minutes from the time of the last exposure. Such small images can be viewed directly, in a simple magnifying viewer, or by projection; photographic enlargements may be used as the clinical film records.

Figure 2 shows the comparative diagnostic quality of conventional "spot" roentgenograms versus that of Polaroid film photofluorograms. Obviously very useful information can be recorded by this technique despite the evident loss in resolution. The exposure times recorded show that the Polaroid film-intensifier combination requires the same or slightly less radiation exposure when the 8 inch lens is employed; with the 4 inch lens the radiation required is about one-quarter that for a comparable conventional roentgenogram.

This application of presently available electronic and photographic techniques points one way for future developments which certainly herald rapid and dramatic changes in the nature of clinical diagnostic radiologic practice.

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1. STAUFFER, H. M., OPPENHEIMER, M. J., STEWART, G. H., III, and BLACKSTONE, A. W. Practical image amplifier technics; fluoroscopy, cinefluorography, spot-film radiography and use with closed circuit television. *Radiology*, 1955, *65*, 784.

VOL. 79, NO. 5

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

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Published by: CHARLES C THOMAS, PUBLISHER, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $15.00; Canada, $16.00; other countries, $17.00. Current single numbers, $1.50. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page vi.

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Forty-first Annual Meeting: To be announced.

EDITORIALS

CHOLECYSTOGRAPHY TODAY

ONE of the conspicuous landmarks in the history of medicine was the announcement in 1924 by Graham and Cole[1] of a method for making the gallbladder visible on the roentgenogram. Prior to that time the roentgenologic contribution to the diagnosis of cholecystic disease consisted of the occasional demonstration of calcified gallstones or of the distended and inflamed organ itself.

Within a year after this announcement Menees and Robinson[2] had described the oral administration of tetrabromophthalein sodium, and shortly thereafter Whitaker, Milliken and Vogt[3] advocated the oral use of the iodine salt. Cholecystography thenceforth became so firmly established as a useful diagnostic tool that in 1928 Kirklin[4] was able to write, "Within the short space of three years cholecystography has attained high eminence among diagnostic procedures, and its wide employment is sufficient proof of its general excellence."

During the early years a search was carried out for other contrast media which might be more efficient or might cause less unpleasant side reactions, and certain refinements of roentgenographic technique were advocated. Nevertheless the method changed very little in the next twenty-five years; the basic principles were well understood, and the results were interpreted with proper conservatism. Seldom has a diagnostic procedure with such wide application become established so rapidly and so firmly, and seldom has one been employed for so long without fundamental improvements.

Finally, in the past decade, some major changes have taken place. Denser media have been developed which have replaced tetraiodophthalein sodium. Greater doses of these media have been advocated, with some roentgenologists employing a "double dose" technique. Roentgenograms are obtained in the upright and the lateral decubitus positions as well as in the more routine prone or prone-oblique attitudes. Some patients are prepared for the test by being given a meal containing a large amount of fat, while others are allowed to complete the procedure without ingesting the "fat meal" before the final roentgenograms are made. What, we may ask, have been the results of these innovations? How much has diagnostic accuracy been improved? Has there been any change in basic physiologic principles or in the philosophy of interpretation of results?

Cholecystography is primarily a test of the functional integrity of the biliary tract *at the time the test is performed.* Except for the demonstration of stones and tumors, little reliance can be placed on anatomic form, which is the basis of roentgenologic diagnosis in most other organ systems. Five physiologic mechanisms are necessary for the proper functioning of the test:

1. The ingested contrast medium must be absorbed into the circulation in sufficient quantity. (This statement does not pertain, of course, if the medium is introduced directly into the blood stream.)

2. The contrast medium must be excreted in sufficient quantity by the liver.

3. The duct system must be patent.

[1] Graham, E. A., and Cole, W. H. Roentgenologic examination of gallbladder, new method utilizing intravenous injection of tetrabromphenolphthalein. *J.A.M.A.*, 1924, *82*, 613–614.

[2] Menees, T. O., and Robinson, H. C. Oral administration of sodium tetrabromphenolphthalein; preliminary report. Am. J. Roentgenol. & Rad. Therapy, 1925, *13*, 368–369.

[3] Whitaker, L. R., Milliken, G., and Vogt, E. C. Oral administration of sodium tetraiodophenolphthalein for cholecystography. *Surg., Gynec. & Obst.*, 1925, *40*, 847–851.

[4] Kirklin, B. R. Efficiency and limitations of cholecystography. *Boston M. & S. J.*, 1928, *197*, 1487–1493.

4. There must be a satisfactory resistance mechanism at the terminus of the common duct.

5. The gallbladder must be capable of concentrating the bile.

Probably the use of denser media has made the task of the radiologist easier. The gallbladder is more readily located on the survey roentgenogram and smaller cones can be employed subsequently, with enhancement of detail. Also, these media have been of value in demonstrating a greater number of nonopaque stones in gallbladders which did not concentrate the older media sufficiently. However, it must be remembered that these same cases have always been classified with the diseased group, just as they are today—formerly because of nonvisualization or the presence of a faint shadow, now because stones are demonstrated.

On the other hand, there is a definite danger that the denser media and the larger doses in which they are employed may cause a gallbladder to appear normally dense which in former days would not have been visualized at all or which would have shown only a faint shadow. That most such organs are diseased has been proved many times by many authors. As a case in point, demonstration of the shadow of the gallbladder after intravenous administration of iodipamide (cholografin) does not mean that the organ can concentrate bile and function in a normal manner. If the medium can opacify the common duct before the medium-containing bile has been concentrated in the gallbladder, it can cause a diseased organ to cast a shadow despite inability to absorb water.

Today one seldom sees a report of "faint shadow," "poor visualization," or "poorly functioning gallbladder." Either the stones which are present in about three fourths of these formerly obscure instances have been demonstrated and reported, or the fact that the ability of the organ to concentrate bile is below normal has been overlooked because of what appears to be a normally dense shadow. Some radiologists may argue it is a good thing that borderline diagnosis has been eliminated, that now we recognize only black and white. Yet the patients in this particular group suffer from cholecystic disease in about 19 out of 20 instances, and a few patients who might benefit from cholecystectomy perhaps are being deprived of surgical treatment because of the erroneous results of cholecystography.

One final change in method must be remarked upon—the tendency to omit the fat meal and the subsequent roentgenogram. Such a procedure is unnecessary, it must be admitted, when stones are demonstrated or when the organ fails to cast a shadow. However, much is to be gained by the routine use of this technique in all other cases. In spite of the ability of roentgenograms of the upright or the lateral decubitus position to demonstrate more stones and tumors than the routine views, a certain few will not be shown until the gallbladder has contracted and emptied itself of a portion of the medium. Tiny stones, minute cholesterol polyps, and particularly that infrequent tumor of the fundic end, the adenomyoma, are best seen at this time. The additional observation that the organ has changed in size will save the examiner the embarrassment of mistaking a hydropic gallbladder for one which is functioning in a normal manner.

Some comment should be made on the role of intravenous cholangiography in the diagnosis of biliary disease. After the gallbladder has been removed, this method frequently is of great assistance in recognizing stones or stricture in the common duct, and also the presence of remnants of the cystic duct and of anomalous junctions of the cystic and common ducts. It is even possible to demonstrate, on occasion, the presence of a diseased gallbladder which the patient believes to have been removed, and which could not be recognized by any other roentgenologic means. However, the procedure should not be used to replace conventional cholecystography. Visualization of the gallbladder following intravenous injection of cholografin, as has been said

before, does not necessarily mean that the organ is normal and has retained the ability to concentrate bile.

It is interesting to compare the results of an analysis of 732 patients operated on in 1932 as reported by Kirklin[5] with a similar analysis of 1,180 patients operated on in 1955 as reported by Baker and Hodgson.[6] Of the gallbladders in the earlier group which failed to cast a shadow, 97.1 per cent were found to be diseased by the pathologist, while of the later group, 97.2 per cent were not normal. (Stones were present in 84.9 per cent of Kirklin's group of "nonfunctioning gallbladders," and in 80.2 per cent of those reported by Baker and Hodgson.) When the presence of cholelithiasis was recognized in 1932, stones were found by the surgeon in 99.6 per cent of cases. In 1955 this figure was 99.1 per cent. It seems obvious that the newer techniques have not improved the reliability of these two diagnoses.

Only in the case of the "poorly functioning gallbladder" in which no stones can be demonstrated is there much of a discrepancy between the two series of cases. In 1932 about 5 per cent of the gallbladders cast what was thought to be a faint shadow, and 94.8 per cent of these were found at operation to be diseased. *In 1955 this diagnosis was not made in a single case!* One can ask, "Were some diseased gallbladders overlooked in 1955 because of the more dense contrast medium?"

This comparison of results seems to indicate that modern innovations have not improved appreciably the reliability of cholecystographic diagnosis. It also seems to indicate that modern roentgenologists would do well to remember the basic physiologic and pathologic principles on which cholecystography is based. While the procedure is amazingly accurate for one in such general use, it has been recognized from the beginning that a diseased organ may cast a normally dense shadow and that once in a while a normal gallbladder may not be visualized.

Certain statements made by Kirklin[7] before the Second International Congress of Radiology in 1928 are just as valid today as then, and they deserve reiteration: "Like all laboratory tests, especially those applied with the x-ray, the greatest misfortune to cholecystography has been, not the scant criticism it has received, but the tendency to credit it with infallibility and to depend supinely on its verdicts. In spite of [its] general efficiency, it has its limitations and is subject to errors of interpretation many of which will probably continue to be inevitable . . . . A keener realization that the diagnosis of cholecystic disease is ultimately the function of the clinician and not of cholecystography or any other laboratory test is urgently to be desired. . . . "

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[5] Kirklin, B. R. Persisting errors in technic of oral cholecystography: Procedure designed to avoid them. *J.A.M.A.*, 1933, *101*, 2103–2105.

[6] Baker, H. L., Jr., and Hodgson, J. R. Oral cholecystography: Evaluation of its accuracy. To be published.

[7] Kirklin, B. R. Cholecystography; general appraisal. *Arch. Surg.*, 1929, *18*, 2246–2256.

RALPH S. BROMER, M.D.
1886–1957

RADIOLOGY lost one of its outstanding members in the passing of Ralph Shepherd Bromer, M.D., September 25, 1957, in the Bryn Mawr Hospital, after a brief illness. At the time of his death, he was Consulting Radiologist to the Bryn Mawr and Children's Hospitals, and Emeritus Professor of Radiology at the Graduate School of Medicine, University of Pennsylvania.

Doctor Bromer was graduated from Yale University in 1908 and received his medical degree from the University of Pennsylvania in 1912. Additional training was taken at the Children's Hospital, Boston, and he was radiologist and Adjutant with Base

Hospital 34, in France, during the first World War. In 1919, Doctor Bromer joined the Staffs of Episcopal, Orthopedic and Children's Hospitals of Philadelphia. He served the latter institution as radiologist for thirty years. In 1932, he was appointed radiologist to the Bryn Mawr Hospital, where he remained as Director of the Department until his retirement in 1955. For many years, he taught in the Graduate School of the University of Pennsylvania, and was Radiologic Consultant to the Pennsylvania Railroad.

Through the years, Ralph showed keen interest in the activities of the American Roentgen Ray Society, and he served on many of its committees. The Society elected him President in 1942. He served as a member of the American Board of Radiology for a number of years. His long experience at the Orthopedic and Children's Hospitals and his interest in abnormalities of the osseous system resulted in knowledge that won him recognition as an expert in this field. Many lectures and scientific contributions on this and other radiologic subjects were always well received and appreciated. Among other outstanding lectures that he delivered were the George W. Holmes Lecture to the New England Roentgen Ray Society and the Pancoast Memorial Lecture before the Philadelphia Roentgen Ray Society.

He is survived by his wife, the former Alice Rupp; a son, Ralph, Jr.; a daughter, Catherine, and four grandchildren. Ralph's modesty and kindness endeared him to a wide host of acquaintances and all held him in high esteem. These and his close friends join the family in mourning for the passing of a fine gentleman and radiologist.

Barton R. Young, M.D.

SOCIETY PROCEEDINGS AND NEWS ITEMS

MEETINGS OF RADIOLOGICAL SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. C. Allen Good, Mayo Clinic, Rochester, Minn. Annual meeting: Shoreham Hotel, Washington, D. C., Sept. 30–Oct. 3, 1958.

American Radium Society
Secretary, Dr. Theodore R. Miller, 139 East 36th St., New York 16, N. Y. Annual meeting: To be announced.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: Palmer House, Chicago, Ill., Nov. 16–21, 1958.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois. Annual meeting: To be announced.

Section on Radiology, American Medical Association
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich. Annual meeting: June 23–27, 1958, San Francisco, Calif.

American Board of Radiology
Secretary, Dr. H. Dabney Kerr. Correspondence should be directed to Kahler Hotel Building, Rochester, Minn. Spring 1958 Meeting and Examinations May 19–23, inclusive; Second Special Examination in Nuclear Medicine for Diplomates, May 17, 1958, Palmer House, Chicago, Ill.

Ninth International Congress of Radiology
Secretary-General, Dr. Hans v. Braunbehrens. Request for information should be addressed to Dr. Viktor Loeck, Kongressbüro, Forsthausstrasse 76, Frankfurt am Main, Germany. Meets in Munich, Germany, July 23 to July 30, 1959.

Sixth Inter-American Congress of Radiology
Secretary for North America, Dr. Jorge de la Flor, Hospital Arzobispo Loayza, Lima, Perú. Meets in Lima, Perú, Nov. 2–8, 1958.

Alabama Radiological Society
Secretary Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

American Nuclear Society
Executive-Secretary, Dr. W. W. Grigorieff, P. O. Box 963, Oak Ridge, Tenn. Annual meeting: First week in June, 1958, Los Angeles, Calif.

Arizona Radiological Society
Secretary, Dr. R. Lee Foster, 1313 N. Second St., Phoenix, Ariz. Two regular meetings a year. Annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. E. A. Mendelsohn, Holt-Krock Clinic, Fort Smith, Ark. Meets every three months and also at time and place of State Medical Association.

Association of University Radiologists
Secretary, Dr. Paul Riemenschneider, Medical College, State University of New York, Syracuse, N Y.

Atlanta Radiological Society
Secretary, Dr. Luther Clements, 35 Linden Ave., N.E., Atlanta 8, Ga. Meets monthly, except during three summer months, on second Friday evening.

Blockly Radiological Society
Secretary, Dr. Samuel Finkelman, 101 S. Twentieth St., Philadelphia, Pa.

Brooklyn Radiological Society
Secretary, Dr. Solomon Schwartz, 555 Prospect Place, Brooklyn, N. Y. Meets first Thursday of each month October through May.

Buffalo Radiological Society
Secretary, Dr. Charles Bernstein, 685 Delaware Ave., Buffalo 9, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Joseph A. Head, 150 Marshall St., Syracuse, N. Y. Meets first Monday each month October through May.

Central Ohio Radiological Society
Secretary, Dr. Arthur R. Cohen, 41 S. Grant Ave., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, November, January, March and May at Fort Hayes Hotel, Columbus, Ohio.

Central Society of Nuclear Medicine
Secretary, Dr. Robert S. Landauer, Radiation Center Building, 1903 West Harrison St., Chicago 12, Ill.

Chicago Roentgen Society
Secretary, Dr. Arthur S. J. Petersen, 11406 Parnell Ave., Chicago 28, Ill. Meets second Thursday of each month, October to April inclusive at the Sheraton Hotel at 8:00 P.M.

Cleveland Radiological Society
Secretary, Dr. Frederick A. Rose, 2065 Adelbert Rd., Cleveland 6, Ohio. Meetings at 7:00 P.M. on fourth Monday of each month from October to April at Tudor Arms Hotel.

Colorado Radiological Society
Secretary, Dr. Lorenz R. Wurtzebach, 601 E. Nineteenth Ave., Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. Paul J. Kingston, 114 Woodland St., Hartford, Conn. Meets first Friday in February and April.

Dallas-Fort Worth Radiological Club
Secretary, Dr. A. H. Keene, 3707 Gaston Ave., Dallas, Texas. Meets monthly, third Monday, at Greater Fort Worth International Airport at 6:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. Joseph O. Reed, Jr., Harper Hospital, Detroit, Mich. Meets monthly first Thursday, October through May, at David Whitney House, 4421 Woodward Ave., at 6:30 P.M.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Eastern Radiological Society
Secretary, Dr. John D. Osmond, Jr., Euclid-Glenville Hospital, Cleveland 19, Ohio.

Florida Radiological Society
Secretary, Dr. C. Robert DeArmas 135 Broadway, Daytona Beach, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
wick, Ga. Meets Spring and Fall with Annual State Society Meeting.

Greater Miami Radiological Society
Secretary, Dr. George P. Daurelle, Jackson Memorial Hospital, Miami 36, Fla. Meets monthly third Wednesday at 8 P.M. at Jackson Memorial Hospital, Miami, Fla.

Greater St. Louis Radiological Society
Secretary, Dr. Charles J. Cherre, 462 N. Taylor, St. Louis 8, Mo.

Houston Radiological Society
Secretary, Dr. Edward B. Singleton, 6621 Fannin St., Houston 25, Texas. Meets last Monday each month, Seminar Room, Doctors' Club of Houston.

*** Secretaries of societies are requested to send timely information promptly to the Editor.**

Idaho State Radiological Society
Secretary, Dr. Charles R. McWilliams, Magic Valley Memorial Hospital, Twin Falls, Idaho. Meets annually at same time as Idaho State Medical Association.

Illinois Radiological Society
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. C. A. Stayton, 313 Hume-Mansur Bldg., Indianapolis 4, Ind. Meets first Sunday in May and during fall meeting of Indiana State Medical Association.

Iowa Radiological Society
Secretary, Dr. James T. McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

Kansas Radiological Society
Secretary, Dr. James R. Stark, 3244 E. Douglas, Wichita, Kansas. Meets in spring with State Medical Society, and in winter on call.

Kentucky Radiological Society
Secretary, Dr. Robert H. Akers, 1405 West Broadway, Louisville 3, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Kings County Radiological Society
Secretary, Dr. C. P. Naidorf, 411 Parkside Ave. Brooklyn 26, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. Putnam C. Kennedy, 540 N. Central Ave., Glendale 3, Calif. Meets second Wednesday of month in September, November, March, April and June at Los Angeles County Medical Association Building, Los Angeles.

Maine Radiological Society
Secretary, Dr. Francis J. O'Connor, Augusta General Hospital, Augusta, Maine. Meets in June, September, December and March.

Maryland Radiological Society
Secretary, Dr. Nathan B. Hyman, 1805 Eutaw Place, Baltimore 17, Md.

Memphis Roentgen Society
Secretary, Dr. James L. Booth, 899 Madison Ave., Memphis 3, Tenn. Meets first Monday of each month at John Gaston Hospital.

Miami Valley Radiological Society
Secretary, Dr. S. F. Johnson, 2197 Los Arrow Dr., Dayton 9, Ohio. Meets second Friday of fall and winter months.

Mid-Hudson Radiological Society
Secretary, Dr. Joseph Sorrentino, St. Francis Hospital, Poughkeepsie, N. Y. Meets 8:30 P.M., fourth Wednesday each month, September to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. R. W. Byrne, 3321 N. Maryland Ave., Milwaukee 11, Wis. Meets monthly on fourth Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. O. J. Baggenstoss, 1953 Medical Arts Bldg., Minneapolis 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Mississippi Radiological Society
Secretary, Dr. Robert P. Henderson, 316 Medical Arts Bldg., Jackson, Miss. Meets third Thursday of each month at Hotel Edwards, Jackson, at 6:00 P.M.

Montana Radiological Society
Secretary, Dr. Arthur T. Austin, 104 The Doctors Bldg. Billings, Montana. Meets at least once a year.

Nassau Radiological Society
Secretary, Dr. Jerome Zwanger, 126 Hicksville Rd., Massapequa, L. I., N. Y. Meets second Tuesday of the month in February, April, June, October and December.

Nebraska Radiological Society
Secretary, Dr. J. F. Kelly, Jr., 816 Medical Arts Bldg., Omaha, Neb. Meets third Wednesday of each month at 8:30 P.M. in Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. John E. Gary, 1180 Beacon St., Brookline 46, Mass. Meets third Friday of each month, October through May, at Hotel Commander, Cambridge, Mass.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Harold G. Jacobson, 210th St. and Bainbridge Ave., New York 67, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 4:30 P.M.

North Carolina Radiological Society
Secretary, Dr. William H. Sprunt, North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. Marianne Wallis, St. Joseph's Hospital, Minot, N. D. Meetings by announcement.

North Florida Radiological Society
Secretary, Dr. Marvin Harlan Johnston, Five Points Medical Center, Jacksonville 4, Fla. Meets quarterly in March, June, September and December.

Northeastern New York Radiological Society
Secretary, Dr. Irving Van Woert, Jr., Albany Hospital, Albany, N. Y. Meets in Albany area on second Wednesdays of October, November, March and April.

Northern California Radiological Society
Secretary, Dr. H. B. Stewart, 2920 Capital Ave., Sacramento, Calif. Meets at dinner last Monday of each month, September to June.

Ohio State Radiological Society
Secretary, Dr. Francis C. Curtzwiler, 421 Michigan St., Toledo 2, Ohio. Annual meeting: May 16–18, 1958, Wade Park Manor Hotel, Cleveland, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. Sol Wilner, St. John's Hospital, Tulsa, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. C. V. Allen, Veterans Hospital, Portland, Ore. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets second Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. Robert W. Hanf, 900 S. Auburn, Kennewick, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco 8, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. Walter P. Bitner, 234 State St., Harrisburg, Pa. Annual meeting: Penn Sheraton Hotel, Pittsburg, Pa., May 15–17, 1958.

Philadelphia Roentgen Ray Society
Secretary, Dr. Roderick L. Tondreau, 3400 Spruce St., Philadelphia 4, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. Edward M. Schultz, 3401 Fifth Ave., Pittsburgh 13, Pa. Meets second Wednesday of month, October through June at Hotel Roosevelt.

Radiological Section, Baltimore Medical Society
Secretary, Dr. James K. V. Willson, 1100 N. Charles St., Baltimore 1, Md. Meets third Tuesday each month, September to May, inclusive.

Radiological Section, Southern Medical Association
Secretary, Dr. Ted F. Leigh, Emory University, Georgia. Annual meeting: To be announced.

Radiological Society of Greater Cincinnati
Secretary, Dr. Warner Peck, Carew Tower St., Cincinnati 2, Ohio. Meets monthly from September to May on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

Radiological Society of Hawaii
Secretary, Dr. Jun-chu'an Wang, The Queen's Hospital,

Honolulu 9, Hawaii. Meets third Monday of each month alternately at 4:30 P.M. and 7:30 P.M.

Radiological Society of Greater Kansas City
Secretary, Dr. E. H. Stratemeier, Jr., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Radiological Society of Louisiana
Secretary, Dr. Seymour Ochsner, Ochsner Clinic, New Orleans 15, La. Meets annually during Louisiana State Medical Society Meeting.

Radiological Society of New Jersey
Secretary, Dr. Andrew P. Dedick, Jr., 67 E. Front St., Red Bank, N. J. Meets at Atlantic City at time of State Medical Society and in November in Newark, N. J.

Radiological Society of New York State
Secretary-Treasurer, Dr. Mario C. Gian, 610 Niagara St., Buffalo 1, N. Y. Meets with the State Medical Society in New York, May 11–16, 1958.

Radiological Society of South Dakota
Secretary-Treasurer, Dr. Donald J. Peik, 303 S. Minnesota Ave., Sioux Falls, S. D.

Radiological Society of Southern California
Secretary, Dr. Harold P. Tompkins, 658 S. Westlake, Los Angeles 57, Calif.

Redwood Empire Radiological Society
Secretary, Dr. Lee E. Titus, 164 W. Napa St., Sonoma, Calif. Meets second Monday every other month.

Richmond County Radiological Society
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga. Meets first Thursday of each month at various hospitals.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. John W. Colgan, 277 Alexander St., Rochester 18, N. Y. Meets at 8:15 P.M. on the last Monday of each month, September through May, at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. John H. Freed, 4200 East Ninth Ave., Denver 20, Colo. Annual meeting: Shirley Savoy Hotel, Denver, Colo., Aug. 14–16, 1958.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Jr., 3720 Washington Ave., St. Louis 8, Mo. Meets fourth Wednesday each month, except June, July, Aug. and Sept.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets third Wednesday each month in Fort Sam Houston Officer's Club at 6:30 P.M.

San Diego Radiological Society
Secretary, Dr. Stanley A. Moore, 2466 First Ave., San Diego 1, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. Irma Smith, 450 Sutter St., San Francisco 8, Calif. Meets quarterly at Grison's Steak House.

Section on Radiology, California Medical Association
Secretary, Dr. Nathan M. Spishakoff, 405 N. Bedford Dr., Beverly Hills, Calif.

Section on Radiology, Connecticut State Medical Society
Secretary, Dr. Ralph J. Littwin, Bristol Hospital, Bristol, Conn. Meetings are held bi-monthly.

Section on Radiology, Medical Society of the District of Columbia
Secretary, Dr. Charles E. Bickham, Jr., 1835 Eye St., N.W., Washington 6, D. C. Meets Medical Society Library, third Wednesday of January, March, May and October at 8:00 P.M.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. William Meszaros, 1825 W. Harrison St., Chicago, Ill.

Shreveport Radiological Club
Secretary, W. R. Harwell, 608 Travis St., Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M. September to May inclusive.

Society of Nuclear Medicine
Secretary, Dr. Robert W. Lackey, 452 Metropolitan Bldg., Denver 2, Colo. Annual meeting: June 19–21, 1958, Beverly Hilton Hotel, Los Angeles, Calif.

South Bay Radiological Society
Secretary, Dr. Stanford B. Rossiter, 1111 University Dr., Menlo Park, Calif. Meets second Wednesday of each month.

South Carolina Radiological Society
Secretary, Dr. Wayne Reeser, 804 Burroughs St., Conway, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Southern Radiological Conference
Secretary, Dr. Marshall Eskridge, Mobile Infirmary, Mobile, Ala.

Southwestern Radiological Society
Secretary, Dr. Gordon Black, Suite 2-A, El Paso Medical Center, 1501 Arizona, El Paso, Texas. Meets second Tuesday of each month.

Tennessee Radiological Society
Secretary, Dr. G. K. Henshall, 311 Medical Arts Bldg., Chattanooga 3, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. J. E. Miller, Baylor Hospital, Dallas, Texas. Next meeting January 30 and 31, 1959, Statler-Hilton Hotel, Dallas, Texas.

Tri-State Radiological Society
Secretary, Dr. Robert E. Beck, 600 Mary St., Evansville, Ind. Meets last Wednesday of Oct., Jan., March and May, 8:00 P.M. at Elks' Club in Evansville.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May, Service Memorial Institute.

Upper Peninsula Radiological Society
Secretary, Dr. A. Gonty, Menominee, Mich. Meets quarterly.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets fourth Wednesday in January, March, May, September and November at Holy Cross Hospital.

Virginia Radiological Society
Secretary, Dr. Frank A. Kearney, II, 110 S. Curry St., Phoebus, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Eva L. Gilbertson, 1317 Marion St., Seattle 4, Wash. Meets fourth Monday of each month from September through May at 610 Pine St., Seattle.

West Virginia Radiological Society
Secretary, Dr. W. Paul Elkin, 515 Medical Arts Bldg., Charleston, W. Va. Meets concurrently with annual meeting of West Virginia State Medical Society; other meetings arranged by program committee.

Westchester Radiological Society
Secretary, Dr. Arnold Myron Wald, 406 Boston Post Road, Port Chester, N. Y. Meets on third Tuesday of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. Farrell F. Golden, 5221 Tonyawatha Trail, Madison 4, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. John H. Heald, 450 Sutter St., San Francisco 8, Calif. Meets monthly, third Thursday at 7:30 P.M., Children's Hospital, September through June.

Cuba, Mexico, Puerto Rico and Central America

Asociación de Radiólogos de Centro America y Panamá
Comprising: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panamá, *Secretary-General*, Dr. Roberto Calderón, Calle Central Deste No. 218, Managua, Nicaragua. Meets annually in a rotating manner in the six countries.

Sociedad de Radiología y Fisioterapía Cubana
Secretary, Dr. Miguel A. García Plasencia, Hospital Curie, 29y F-Vedado, Habana, Cuba. Meets monthly at Curie Hospital.

Sociedad Costarricense de Radiologia
Secretary, Dr. James Fernández Carballo, Apartado VIII, San José, Costa Rica.

Sociedad Mexicana de Radiología, A. C.
Calle del Oro No. 15, México 7, D. F.
Secretary-General, Dr. Guillermo Santín. Meets first Monday of each month.

Asociación Puertorriqueña de Radiología
Secretary, Dr. R. B. Díaz Bonnet, Suite 504, Professional Bldg., Santurce, Puerto Rico.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sánchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

Association of Radiologists of the Province of Quebec
Secretary, Dr. Isadore Sedlezky, 3755 Cote St. Catherine Rd., Montreal, Que. Meets four times a year.

British Institute of Radiology Incorporated with the Röntgen Society
Honorary Secretary, Dr. John Blewett, 32 Welbeck St., London, W. 1. Meets monthly from October until May.

Faculty of Radiologists
Honorary Secretary, Dr. R. A. Kemp Harper, 47, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Canadian Association of Radiologists
Honorary Secretary, Dr. Guillaume Gill, *Associate Honorary Secretary*, Dr. Robert G. Fraser, 1555 Summerhill, Montreal 25, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electro-Radiologie Médicale
General Secretary, Dr. Louis Ivan Vallée, 1058 rue St-Denis, Montreal 18, Canada. Meets third Saturday each month.

Toronto Radiological Society
Secretary, Dr. L. R. Harnick, Toronto Western Hospital, 399 Bathurst St., Toronto, Ontario. Meets second Monday of each month September through May.

College of Radiologists of Australasia
Honorary Secretary, Dr. Arthur B. Sullivan, c/o British Medical Agency, 135 Macquarie St., Sydney, N.S.W. Australia.

South America

Asociación Argentina de Radiología
Secretary, Dr. Lidio G. Mosca, Avda. Gral. Paz 151 Córdoba, Argentina. Meetings held monthly.

O Colégio Brasileiro de Radiologia
Secretary-General, Dr. Walter Bomfins Pontes. Seat: Rua Major Quedinho, 99-2°. Andar, São Paulo, Brazil.

Sociedad Argentina de Radiología, Junta Central, Buenos Aires
Secretary, Dr. Juan L. Ambrogna, Montevideo 745, Buenos Aires. Meetings are held monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem. de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Chilena de Radiologia
Secretary, Dr. Armando Doberti, Merced 565, Santiago, Chile. Meets fourth Friday of each month.

Sociedad Colombiana de Radiologia
Secretary, Dr. Alberto Mejia Dzg., Carrera 13, No. 25–31, Apartado aéreo No. 5804, Bogotá, Colombia. Meets last Thursday of each month.

Sociedad Ecuadoriana de Radiologia y Fisioterapia
Secretary, Dr. Enrique Ortega Guzmán, Casilla 4719, Guayaquil, Ecuador.

Sociedad Peruana de Radiologia
Secretary, Dr. Luis Pinillos G. Apartado 2306, Lima, Perú. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta 218, Lima.

Sociedad de Radiologia del Atlantico
Secretary, Dr. Raul Fernandez, Calle 40 #41-110, Baranquilla Colombia. Society meets monthly at the Instituto de Radiologia.

Sociedad de Radiología, Cancerología y Física Médica del Uruguay
Secretary-General, Dr. Roberto François, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Sociedade de Radiologia de Pernambuco
Secretary, Dr. Manoel Medeiros, Instituto de Radiologia da Faculdade de Medicina da Universidade do Recife, Caixa Postal 505, Pernambuco, Brazil.

Sociedad Venezolana de Radiología
Secretary, Dr. Otto Paz, Centro Médico, Caracas, Venezuela. Meets monthly third Friday at Colegio Médico del Distrito Federal Caracas.

Continental Europe

Austrian Roentgen Society
President, Dr. Konrad Weiss, Mariannengasse 10, Vienna 9, Austria. Meets second Tuesday of each month in Allgemeine Poliklinik.

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 256 Chaussée de Wavre, Heverlee-lez-Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, du Nord, de l'Ouest, de l'Est, et d'Alger et d'Afrique du Nord.
Secretary-General, Dr. Ch. Proux, 9, rue Daru, Paris 8e, France. Meets annually.

Ceskoslovensk společnost pro Rëntgenologii a Radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Deutsche Röntgengesellschaft
Secretary, Professor Dr. med. H. Lossen, Universitäts-Röntgeninstitut, Lagenbeckstr. 1, Mainz, Germany. Meets beginning of Oct., 1958 in Bremen. President of Congress, Professor Dr. du Mesnil de Rochemont, Universitäts—Strahlenklinik, Marburg, Germany.

Società Italiana di Radiologia Medica e di Medicina Nucleare
Secretary, Dr. Ettore Conte, Ospedale Mauriziano, Torino, Italy. Meets annually.

Nederlandse Vereniging voor Electrologie en Röntgenologie
Secretary, Dr. J. R. von Ronnen, Violenweg 14, den Haag, Netherlands.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Española de Radiologia y Electrologia
Secretary, Dr. D. Aureo Gutierrez Churruca, Esparteros, No. 9, Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgengesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

India

Indian Radiological Association
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

The next list of Meetings of Radiological Societies will be published in the July issue of the Journal.

SIXTH INTER-AMERICAN CONGRESS OF RADIOLOGY

Professor Oscar Soto, President of the Sixth Inter-American Congress of Radiology, addresses the following invitation to all radiologists of the Americas:

"When Lima was designated as the seat of the Sixth Inter-American Congress, we were as acutely conscious of the great honor conferred, as of the great responsibility involved.

"Since then it has been our constant endeavour to be worthy of the confidence reposed in us. We hope that the next Congress will not fall short of the brilliance and prestige of those that have preceded it; but we realize that this can only be accomplished with the help and collaboration of our many friends and colleagues in the Americas as its determining factor.

"We ask you therefore to honor us with your presence, and to give us the benefit of your invaluable experiences in the many spheres of our specialty, knowing that the true success of these Congresses lies in the spirit of scientific inquiry they engender. We feel too, that this cooperation will enable us all to create new ties as well as to strengthen those which already exist among the members of our profession.

"This harmonious alliance is an increasing necessity in view of the ever widening, indeed almost unpredictable horizons opening up in the field of Radiology in this new era of atomic energy.

"We sincerely hope that all the radiologists of the American Continent who are in a position to do so, will concur in this new appointment with the Future, and hand on the torch of their knowledge and their wisdom.

"We will expect you then in Lima from the 2nd to the 8th of November 1958, for a stay which we all hope will be to your pleasure and advantage; and can assure you now that for us, the radiologists of Perú, your visit will be an unforgettable experience, though unfortunately far too brief."

Oscar Soto, M.D., President

An excellent program has been arranged. The registration will take place Saturday, November 1 and Sunday November 2, 1958. The opening ceremonies will be on Sunday, November 2 at 11 A.M. The Scientific Sessions will start Monday, November 3 and will continue throughout Saturday, November 8. The closing session is to be on Saturday, November 8, at 11 A.M.

In addition to scientific papers, there will be scientific exhibits, technical commercial exhibits, moving pictures, and refresher courses. The National Executive Committee is planning a special program after the Congress for visits to the local hospitals.

The Arne Jensen Travel Agency is the official agent of the Congress and will take care of reservations and transportation, in close cooperation with the Executive Committee in Lima. This agency will arrange tours before and after the Congress for all those who wish to take this opportunity to visit the splendid historical monuments and others places of interest. The address of the Arne Jensen Travel Agency in the United States is 8034 Sunset Boulevard, Hollywood 46, California.

For information concerning registration fees for the various categories of members and for any other aspects of the Congress, please write to: Instituto de Radiología "Cayetano Heredia," Hospital Arzobispo Loayza, Av. Alfonso Ugarte, Lima, Perú.

DR. SOSMAN GIVES FOURTH W. J. AND C. H. MAYO LECTURE

Dr. Merrill Clary Sosman, emeritus professor of roentgenology in the Harvard Medical School and emeritus roentgenologist-in-chief of the Peter Bent Brigham Hospital in Boston, gave the Fourth Annual W. J. and C. H. Mayo Memorial Lecture on "The Accuracy of X-Ray Diagnosis" at Carpenter Hall, Dartmouth College, Hanover, New Hampshire, on March 29, 1958.

THIRD ANNUAL W. EDWARD CHAMBERLAIN LECTURE

The Third Annual W. Edward Chamberlain Lecture in Cardiovascular Roentgenology was given at 4:30 P.M. on Monday, April 21, 1958, in the auditorium of Temple University School of Medicine, Philadelphia, by Dr. Robert F. Rushmer, Professor of Physiology and Biophysics, University of Washington School of Medicine in Seattle. Dr. Rushmer's subject was "Cinefluorographic Studies of Cardiac Function."

We regret to announce the sudden death on March 25, 1958 of Dr. Clarence E. Hufford distinguished member of the American Roentgen Ray Society.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

Lithiase de la Voie Biliare Principale. By Pablo-L. Mirizzi, Professeur à l'Université de Cordoba (Argentine). Paper. Price, 2,200 fr. Pp. 162, with 79 illustrations. Masson et Cie, Éditeurs, 120 boulevard Saint-Germain, Paris 6e, France, 1957.

This is an excellent monograph treating the important problem of lithiasis of the main biliary duct. It summarizes the author's own experience and the work of his collaborators at the Surgical Clinic of the Medical Faculty of Cordoba (Argentina).

The study emphasizes the value of operative cholangiography in detecting not only the number and exact location of calculi, but also the existence and nature of any mechanical hindrance and the degree of functional capacity of the biliary duct.

The author briefly discusses the *preoperative means* at our disposal to investigate the biliary system (clinical examination, plain roentgenography of the hepatic area, cholecystography, intravenous cholangiography, etc.) and the *postoperative methods* (intravenous cholangiography and fistulography). However, according to him, the greatest chance of avoiding residual lithiasis is by systematic use of operative cholangiography, along with the other classical methods.

At the author's clinic, the surgeon works in close collaboration with the radiologist. A 40 per cent iodized oil solution is used as the contrast agent. The technique of injection is described in detail. Likewise the surgical approach for the removal of calculi and for the external drainage is amply discussed.

The monograph contains excellent roentgenographic and diagrammatic reproductions and many drawings of the different surgical procedures. It is recommended to surgeons interested in the difficult biliary field and to radiologists having to interpret the manifold appearances of the opacification of the diseased biliary tract.

H. P. Levesque, M.D.

Clinical Gastroenterology. By Eddy D. Palmer, M.D., F.A.C.P., Lieutenant Colonel, Medical Corps, United States Army; Consultant in Gastroenterology to the Surgeon General. Cloth. Price, $18.50. Pp. 630, with 216 illustrations. Paul B. Hoeber, Inc., 49 East 33rd Street, New York 16, New York, 1957.

This comprehensive guide to digestive tract disorders covers systematically and thoroughly the etiology, pathology, diagnostic tests, therapy and prognosis of each disease condition. New tests and techniques are evaluated and the "uncertain" diseases over which there is much concern and controversy—ulcer, gastric cancer, hepatitis, ulcerative colitis, cirrhosis and portal hypertension—are discussed both in the light of general knowledge and the personal experience of the author.

Written in evenly paced style with prime consideration of the patient as a whole, this well illustrated work is both complete and practical.

William S. Reveno, M.D.

Gastro-Intestinal Obstruction. By Meyer O. Cantor, M.D., M.S., F.A.C.S., Associate Attending Surgeon, Grace Hospital; Attending Surgeon, Sinai Hospital of Detroit; Former Attending Surgeon, Deaconess Hospital; and Roland P. Reynolds, M.D., F.A.C.S., Chief of Surgery, Grace Hospital. Cloth. Price, $18.00. Pp. 565, with 415 illustrations. The Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore 2, Maryland, 1957.

Here in one volume, ably organized by the authors, is gathered all the pertinent information on intestinal obstruction, its recognition and treatment.

Early diagnosis is rightfully emphasized and detailed discussions are presented on involvement of various portions of the gastrointestinal tract, their types and causes and the occurrence of the condition in pregnancy, infancy and the aged. Management in all phases includes outstanding chapters on intubation and nursing technique.

This book is a valuable reference work by clinicians for clinicians.

William S. Reveno, M.D.

L'Intestin Grêle Normal et Pathologique. By E. Chérigié, P. Hillemand, Ch. Proux, and R. Bourbon. Cloth. Pp. 577, with 556

ilustrations. Expansion Scientifique Française, 15 Rue Saint-Benoit, Paris 6e, France, 1957.

This is a masterful work, long awaited and fulfilling a need in a very difficult field of roentgen diagnosis—the normal and pathologic small bowel. The book is written by four internationally known authors who are well aware of what has already been published on the subject. They draw from a rich and original material of more than 2,500 small bowel examinations, most of them with pathologic correlation and performed with the most recent investigative methods—roentgen television and radiocinematography.

The book is divided into 14 major chapters as follows: 1. Generalities on the small bowel (with an embryologic, anatomic and physiologic review of the infantile and adult small bowel). 2. Exploratory methods. 3. Roentgenologic aspects. 4. The main roentgenologic syndromes (abnormalities in motility, tonicity and segmentation; gas and water retention; Koenig's syndrome; occlusive syndrome). 5. Morphologic anomalies. 6. Inflammatory lesions. 7. The small bowel in toxic conditions. 8. Functional derangements. 9. Tumors. 10. Surgical lesions. 11. The small bowel after surgical intervention. 12. The small bowel in hemopathies. 13. Extrinsic deformities. 14. Ileocecal valve pathology.

The legends and summary of each chapter are in French, English and Spanish. The iconography and the accompanying schematic drawings illustrate very clearly the pertinent characteristic features establishing a correct diagnosis. The quality of the reproductions is excellent.

This book is recommended to radiologists, gastroenterologists and all other physicians interested in the possibilities and limitations of the roentgenologic examination of the small bowel.

H. P. Levesque, M.D.

Annual Review of Medicine. Volume 8. 1957. David A. Rytand, Editor. Cloth. Price, $7.00. Pp. 530, with illustrations and tables. Annual Reviews, Inc., Stanford, California, 1957.

This book is divided into twenty-three sections encompassing recent developments in medicine and allied subspecialties. All of the various fields of medicine (except Dermatology) are covered including a short chapter on Obstetrics.

The various sections are written by men outstanding in their field and who write with authority. Room is taken, however, to present conflicting views when this is present in the literature. One slight criticism is the smaller print necessary in a book of this size to present the great amount of material which has been amassed. The bibliographies are extensive, up-to-date, and probably worth the price of the book alone.

The material is presented in a manner emphasizing the physiologic background and giving many of the important experiments in the literature, so one can readily understand the conclusions that are reached. The reviewer feels that physicians can read this with great benefit from a reference standpoint as well as being able to keep abreast of recent developments in medicine.

H. H. Spencer, M.D.

BOOKS RECEIVED

Twenty-third Semiannual Report of the Atomic Energy Commission. By United States Atomic Energy Commission. Paper. Pp. 463, with illustrations and tables. United States Government Printing Office, Washington, D. C., 1958.

La Rœntgenthérapie des Affections Rhumatismales. By Pierre Pizon. Paper. Price, 2,800 fr. Pp. 276, with 60 illustrations. Masson et Cie, Éditeurs, 120 boulevard Saint-Germain, Paris 6e, France, 1957.

A Cirurgia no Sanatório São Lucas. Volume I and Volume II (1939–1949). Paper. Pp. 825, with illustrations. São Paulo Editora, São Paulo, Brazil, 1955.

Aortography; Its Application in Urological and Some Other Conditions. By W. Barr Stirling, Ch.M., F.R.C.S. (Ed.), F.R.F.P.S.G., Senior Assistant, Urological Department, Glasgow Royal Infirmary; Consultant Urologist, Ministry of Pensions. Cloth. Price, $10.00. Pp. 292, with 155 illustrations. The Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore 2, Maryland, exclusive U. S. agents, 1957.

Röntgendiagnostik des lumbalen Bandscheibenrisses und seiner Folgen. Radiologia Clinica. Supplement to Volume 26. By H. H. Weber. Paper. Pp. 72, with 60 illustrations and 5 tables. S. Karger, Basel, Switzerland, 1957.

Der Lungenboeck im Röntgenbild. By Prof. Dr. Karl Wurm, Chefarzt privater Kuranstalten in Höchenschwand I. Schw., a. o. Professor für Inn. Med. der Universität Freiburg/Brsg.; Prof. Dr. H. Reindell, Oberarzt der Med. Universitätsklinik, Leiter der Röntgen-Radium-Abteilung Freiburg/Brsg.; and Prof. Dr. h. c. L. Heilmeyer, Direktor der Med. Universitätsklinik, Freiburg /Brsg. Cloth. Price, DM 78.- -. Pp. 220, with 180 illustrations. Georg Thieme, Herdweg 63, Stuttgart, Germany, 1958.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

Neck and Chest

Arnett, Norman L., and Schulz, Dale M. Primary pulmonary eosinophilic granuloma. *Radiology*, August, 1957, *69*, 224–230. (Address: N. L. Arnett, 9961 Sierra Ave., Fontana, Calif.)

Five cases of eosinophilic granuloma of the lung without other visceral or skeletal involvement are reported to add to the 6 previously reported similar cases. Clinically this disease appears to have a very benign nature. The onset is insidious and the course of the disease is marked by slow progression, followed by regression or prolonged periods of no clinical change. Chronic cough, weight loss, fatigue and low-grade fever are usually the presenting complaints. No specific therapy has been successful.

The roentgen findings consisted of a generalized, disseminated, nodular, granulomatous infiltration in both lung fields. The nodules, varying in size from barely visible to 1.5 cm. lesions, had a soft quality with ill-defined hazy margins that faded into normal parenchyma. A reticulated background of diffuse interstitial fibrosis, with localized radiolucent areas of emphysema was invariably present. This persisted and remained long after the softer components had resolved. Roentgenograms made as long as two years after the initial ones still showed fibrosis and emphysema. In none of these patients have extrapulmonary lesions been demonstrated during their follow-up.

The differential diagnosis includes all disease processes which might produce a granulomatous reaction in lung tissue. Positive diagnosis can be made only by lung biopsy. The roentgen appearance of the lungs in Letterer-Siwe and Hand-Schüller-Christian disease is identical with primary pulmonary eosinophilic granuloma but the former diseases have extrapulmonary involvement. As the microscopic picture is very similar it is thought that they are different manifestations of the same disease process. —*Donald N. Dysart, M.D.*

Soule, A. Bradley, Jr., and Foley, Joseph C. Poisoning from petroleum distillates; the hazards of kerosene and furniture polish. *J. Maine M.A.*, April, 1957, *48*, 103–110. (From: Division of Radiology, University of Vermont College of Medicine and the Mary Fletcher Hospital and deGoesbriand Memorial Hospitals, Burlington, Vt.)

The case histories of 5 patients who ingested kerosene or furniture polish are presented. Postmortem examinations in the 2 fatalities revealed necrotizing bronchopneumonia, congestion of the medullary capillaries and cloudy swelling of the tubules of the kidneys, congestion and edema of the liver and spleen, and intact mucosa of the gastrointestinal tract.

The onset of roentgenographic findings is rapid; it may occur within thirty minutes. The apices and periphery of the lungs are generally clear, and the process is mostly in the bases of the lower lobes. Clinical improvement precedes roentgenographic evidence of resolution.

Animal experiments indicated that the lung involvement is due to aspiration of the petroleum distillates, rather than hematogenous spread from the gastric mucosa. This suggests that gastric lavage may be harmful since it may increase the danger of aspiration during the procedure. Oxygen administration is the most important treatment. Antibiotics should also be given.—*George A. Roberts, M.D.*

Frommhold, W., and Gaul, K. E. Selektive Bronchographie der apikalen Lungensegmente. (Selective bronchography of apical segments.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, Sept., 1957, *87*, 307–312. (Address: W. Frommhold, Falkenreid 16, Berlin-Dahlem, Germany.)

The authors have modified the flexible bronchial catheter (single or double catheter of Nordenstroem) by adding a nozzle, which can be attached to a syringe containing contrast material. The catheter has an initial curvature to correspond to the curvature of the upper lobe bronchus. By inserting a stiff probe, the curvature is straightened out until the tip of the catheter reaches the level of the upper lobe bronchus. Further cautious advancement of the catheter, while removing the probe, permits the catheter to advance into the desired bronchus. The tip of the catheter is large enough so that the walls of the bronchus are approximated, thus preventing any contrast material from flowing proximal to the tip. An opening in the tip of the catheter permits flow of the contrast substance into the upper lobe or apical segment.

Thirty minutes prior to bronchography, the patients are injected subcutaneously with a mixture of 2 mg. of dromoran and 0.2 mg. of lorfan in 1 cc. of solution to reduce the cough reflex without causing respiratory depression.—*J. Zausner, M.D.*

Cimmino, Christian V. The paraspinal-thoracic ratio in chest teleroentgenograms. *Radiology*, August, 1957, *69*, 251–254. (Address: Mary Washington Hospital, Fredericksburg, Va.)

Studies by the author indicate that the position of the thoracic spine in the mid-sagittal plane is a characteristic to be considered in evaluation of the cardiovascular silhouette. From data obtained in a study of 200 adult lateral chest roentgenograms, a paraspinal-thoracic ratio was obtained. It is a measure of the "anteriorness" of the thoracic spine. As

with pectus excavatum, a high ratio may be associated with an unusual cardiac contour. Both are associated with shortening of the anteroposterior diameter of the chest, and both may be considered variants of the flat-chest group.—*Arno W. Sommer, M.D.*

Graeve, K. Zum angiokardiographischen Bild des grossen Aneurysmas der aufsteigenden Aorta mit einseitiger Beeinträchtigung des Lungenkreislaufes. (Angiocardiographic image of the large aneurysm of the ascending aorta with unilateral diminution of the pulmonary circulation.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, Sept., 1957, *87*, 321–325. (Address: 11 Med. Univ.-Klinik, Ziemssenstr. 1, München 15, Germany.)

Angiocardiography was done in two planes simultaneously. The right auricle was displaced downwards and its upper portion was markedly compressed. The left border of the right ventricle reached the left cardiac contour. The pulmonary conus was displaced posteriorly and to the left. The main pulmonary artery assumed a reverse "S"-curve and was displaced similarly to the pulmonary conus. The right and left pulmonary artery were stretched, but the latter was much smaller in caliber, contained less contrast material, and retained the opaque medium two seconds longer than the right artery. Pulmonary veins were not demonstrable on the left side even on delayed exposures. The left ventricle was relatively small and contained little contrast material. Just above the sinus of Valsalva, a large aneurysm of the ascending aorta was seen to reach the anterior chest wall, fill the entire anterior mediastinum, and present a "daughter" aneurysm. According to measurements of the opaque column, the aneurysm was 14.5 cm. in its anteroposterior diameter and its wall was 0.8 cm. thick. The descending aorta was narrow.

The aneurysm compressed the left pulmonary artery so that the left lung had to be supplied by bronchial arteries and the aneurysm also obstructed the left pulmonary vein, thus markedly affecting the circulation in the left lung.—*J. Zausner, M.D.*

Boylston, Bedford F. Oblique roentgenographic views of the cervical spine in flexion and extension; an aid in the diagnosis of cervical subluxations and obscure dislocations. *J. Bone & Joint Surg.*, Dec., 1957, *39-A*, 1302–1309. (From: The Department of Surgery, Baylor University College of Medicine, Houston, Texas.)

Subluxation of the cervical spine after trauma is relatively frequent and the recognition of the responsible anatomic lesion is important. The author states that functional oblique views may allow a more positive diagnosis of acute sprain of the cervical spine in case of traumatic injury when subluxation is not shown by lateral and conventional oblique roentgenograms made with the spine in flexion and extension. He contends that this type of examination is safe after obvious lesions have been ruled out, provided it is supervised by a physician.

The patient is roentgenographed sitting or standing with the body straight but with the head rotated to the side to obtain maximum rotation of the cervical spine. Roentgenograms are then made with the neck extended and with the neck flexed in both oblique views.

Four cases in which this type of examination was carried out are presented. In 2 there was unilateral apophyseal joint subluxation, in one there was unilateral fracture of the articular process and in the fourth there was unilateral fracture-dislocation—*Arthur E. Childe, M.D.*

Fielding, J. William. Cineroentgenography of the normal cervical spine. *J. Bone & Joint Surg.*, Dec., 1957, *39-A*, 1280–1288. (From: The Orthopaedic Service of St. Luke's Hospital, New York, N. Y.)

Cineroentgenographic exposures were made of the cervical spine in motion using an image intensifier and a monitoring system. The average skin dose was 6 r per minute of filming.

1. *Atlanto-occipital articulation.* The only movements are flexion, about 10 degrees and extension, about 25 degrees. The skull and first cervical vertebra move as a unit.

2. *Atlanto-epistrophic articulation.* Rotation: about half the range of rotation of the neck occurs at this level before the spinous process of C2 shows rotation and is then followed by rotation of the remaining cervical vertebrae. When the head is tilted to one side, the spinous processes of C2 and below deviate to the opposite side, indicating rotation. There may also be shift of the first cervical vertebra to the side of the tilt.

Flexion and extension: there is about 10 degrees extension and 5 degrees flexion at this level.

Vertical approximation: there is apparent decrease in the joint spaces as rotation occurs due to the configuration of the facets.

3. *Cervical spine below the second vertebra.* Rotation: same as above.

Flexion and extension: the vertebrae shift anteriorly and posteriorly, this being greatest in the upper cervical region. There is associated narrowing of the intervertebral disk anteriorly with widening posteriorly on flexion, with reverse changes in extension.

In full flexion the facets are almost at the point of subluxation. Adequate foramina are shown even when the facets are fully imbricated in extension. The greatest flexion occurs at the level of C5.

Lateral flexion: rotation always accompanies lateral flexion. The facets on the concave side imbricate. —*Martha Mottram, M.D.*

Cross, Frederick S., Kay, Earle B., and Johnson, George F. Neuromuscular imbalance of the esophagus associated with hiatal hernia as studied by means of cinefluorography and intraluminal pressure recordings. *J. Thoracic Surg.*, Dec., 1957, *34*, 736–748. (From: The Department of Medical Research, the Department of Radiology, and the Division of Surgery, St. Luke's Hospital, Cleveland, Ohio.)

The use of cinefluorography and intraluminal pressure tracings for evaluating neuromuscular changes in the esophagus in association with hiatus hernia is discussed. Normal motility patterns, as well as those found in neuromuscular failure and segmentation, are described. From these studies it has become apparent that the entire esophagus may be altered in association with hiatal hernia. The intraesophageal pressure studies have shown significant changes in the peristaltic activity and intraesophageal pressure relationships. The basic pattern obtained in patients with hiatal hernia has been hypoactivity of esophageal peristalsis, elevated base pressures especially in the lower end, and hyperactivity of the inferior esophageal sphincter. The authors believe that this altered peristaltic activity accounts for the dysphagia frequently associated with hiatal hernia which is out of proportion with other objective findings. If on fluoroscopy or cinefluorography the transit time through the esophagus is delayed either in the lower esophagus due to hyperactivity of the inferior esophageal constrictor, or in the upper esophagus due to generalized hypoactivity in esophageal motility, an undetected hiatus hernia should be suspected. The alteration in intraesophageal pressures with the positive intra-abdominal pressures being transmitted into the esophagus is explained as the basis for the vicious cycle of acid-peptic regurgitation into the esophagus.

The main value of cinefluorography is in its being a permanent dynamic record of esophageal motility. In a discussion following the paper, one of the authors indicates that the output of the roentgen-ray machine in their technical arrangement is 336 r per minute (skin). The maximum exposure period is 15 seconds giving 84 r in the average adult. The size of the field is not discussed.—*Paul C. Olfelt, M.D.*

Teik, Khoo Oon. Pulmonary paragonimiasis; a clinical study of nine cases seen in Singapore. *Proc. Alum. Ass. Malaya*, Sept., 1957, *10*, 189–210. (From: The Department of Clinical Medicine, University of Malaya, Singapore.)

Nine patients with the lung fluke *Paragonimus westermanii* are reported. Although the disease is fairly common along the eastern and southeastern seaboard of Asia, these are the first cases diagnosed in Malaya. In eight of the 9 patients there was a history of eating raw fresh-water crab in Japan. Cough, beginning a month or more after the ingestion of raw crab, was usually the first symptom. After a few months the sputum became brownish or rusty colored and blood streaks appeared, but frank hemoptysis was not seen. Eosinophilia from 12 per cent to 28 per cent was present in all but one of the patients.

The roentgen appearance of paragonimiasis is variable and is easily confused with other diseases, particularly pulmonary tuberculosis. One of the best differential features is the change in appearance within a short period of time, the roentgen abnormalities tending to progress in a fairly specific pattern. In the early stages the flukes incite an "exudative pneumonitis." This later shells out with the formation of smooth-walled cavities or "cysts." The parasites live in these cyst-like burrows and lay their eggs. Their predisposition for the periphery of the lungs explains the frequent pleural reaction with either a serous or a bloody pleural effusion. In late stages the cysts become smaller and more dense and may finally calcify. All the phases of activity may be present simultaneously in either the treated or untreated case.

Large numbers of eggs are present in the sputum and the diagnosis is made by examining fresh unstained sputum under the microscope. The parasites live in the lungs for six years or longer, but the patients remain surprisingly well. Treatment with many different drugs was tried but the parasites were not eradicated. Chloroquin therapy led to an improvement in symptoms in most patients, but the sputum continued to show paragonimus ova.—*J. L. Williams, M.D.*

Sammons, Billy P., Pischnotte, William O., and Williams, John R. A bronchographic sign of chronic bronchitis. *Radiology*, Sept., 1957, *69*, 389–392. (Address: B. P. Sammons, U. S. Naval Hospital, St. Albans 25, L. I., N. Y.)

The authors describe an objective sign, apparently pathognomonic of bronchitis. It consists in the bronchographic demonstration of the dilated mucous gland ducts lining the major bronchi. Routine roentgenograms are of relatively little help in the diagnosis of bronchitis. The bronchogram not only helps exclude other disease processes but is capable of revealing the effects of the irritative processes by filling of the dilated ducts of the mucous glands. These intramural dilated ducts appear as small diverticulum-like projections, filled with the bronchographic medium. In advanced cases there may be localized and

diffuse dilatation of the bronchioles, obliteration of the lumen, purulent bronchitis, small foci of parenchymal consolidation, and abscesses.

Two illustrative cases are presented.—*Arno W. Sommer, M.D.*

Rigler, Leo G. A roentgen study of the evolution of carcinoma of the lung. *J. Thoracic Surg.*, Sept., 1957, *34*, 283–297. (From: The Department of Radiology, University of Minnesota Medical School, Minneapolis 14, Minn.)

For a number of years, the author has been making retrospective observations on chest roentgenograms of patients with histologically proved carcinoma of the lung. He has been able to collect approximately 100 cases in which, fortuitously, a previous roentgenogram of the chest had been made at an interval of three months or more before the diagnosis was established. In the approximately 100 such patients with previous chest roentgenograms available for review, all but 2 showed evidences of an abnormality in the area of the lung later proved to be the location of the carcinoma. These roentgen findings were present in almost all cases long before any significant symptoms were apparent. While such retrospective observations are probably not entirely indicative of the practical possibilities of roentgen diagnosis, they are valid indicators of the natural history of the disease.

The study demonstrates that carcinoma of the lung grows more slowly and over a longer period of time than has generally been supposed. In this series more than 50 per cent of the cases exhibited roentgen evidences of the disease process more than two years prior to either the appearance of symptoms or the determination of a definitive diagnosis. The present study also emphasizes the frequent occurrence of the primary tumor as a peripheral process with late central invasion and subsequent involvement of a major bronchus. During the peripheral stages of the tumor, there was usually an absence of symptoms. Symptoms usually appeared after central invasion with obstruction or other involvement of a large bronchus. The author considers it doubtful that most of the carcinomas of the lung arise in the major bronchi. The logical conclusion is then brought forth that if we could discover peripheral lesions in early stages of their development, not in the early stages of their symptomatology, the possibilities for surgical removal with better results would be enhanced.—*Paul C. Olfelt, M.D.*

Abdomen

Schermuly, W. Möglichkeiten und Grenzen der Beurteilung connataler Darmsitusanomalien. (Possibilities and limitations in the evaluation of congenital abnormalities in position of the bowel.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, August, 1957, *87*, 150–164. (Address: Univ.-Strahlenklinik, Marburg/Lahn, Germany.)

A brief description of the process of development of the midgut in the embryo is given, which facilitates the understanding of the various congenital abnormalities due to malrotation. The 3 most common abnormalities are nonrotation, reversed rotation and malrotation. Intestinal obstruction occurs either due to a common mesentery or to abnormal peritoneal bands or a combination of both. The obstruction is located most frequently in the third part of the duodenum, close to the duodenojejunal flexure, in cecal volvulus and ileocecal intussusception in the lower ileum.

In some cases, only the site of the obstruction can be determined roentgenologically while the underlying error in rotation of the midgut, which will determine the type of operation, is apparent only on laparotomy. For instance, in reversed rotation the intestines occupy apparently a normal position roentgenologically, while in effect the transverse colon instead of the third portion of the duodenum passes behind the superior mesenteric vessels.

Besides acute intestinal obstruction, a chronic, mild duodenal stenosis, which appears often in adults and can be traced back into childhood and adolescence, is described by the author and also by others. Here sometimes coarsening of the mucosal folds of the second portion of the duodenum with irregular cobblestone mucosal pattern and some delay of barium were the only pathologic findings. These changes were caused by an abnormal peritoneal band and disappeared following operation.

The article contains a large number of references and numerous reproductions of roentgenograms and drawings illustrating the abnormalities described.—*Karol E. Matzinger, M.D.*

Pinck, Robert Lloyd, and Mainzer, Robert A. Meconium ileus. Evaluation of a recently described roentgen sign. *Radiology*, August, 1957, *69*, 244–246. (Address: R. L. Pinck, 340 Henry Street, Brooklyn 1, N.Y.)

Meconium ileus was first described by Landsteiner in 1905 and since that time many reports have appeared correlating the condition with pancreatic insufficiency. Neuhauser (1946) found roentgen evidence of air bubbles mixed with thick meconium in 40 per cent of his cases and considered this characteristic of meconium ileus. Bruwer and Hodgson, however, reported a similar observation in imperforate anus. Recently, White maintained that demonstrable gas-fluid levels in such cases were due to complications such as gangrene, volvulus and peritonitis, and that the absence of this sign was more typical of the uncomplicated case.

The authors present a case of meconium ileus in a newborn female infant. The bubble appearance described by Neuhauser, along with several fluid levels

in multiple dilated loops of bowel, was seen on supine roentgenograms. Surgery was performed and no complications were found. Although this study was not felt to completely invalidate White's finding, the authors maintain that the presence of gas-fluid levels did not necessarily signify complications. Accordingly, clinical intestinal obstruction, the demonstration of dilated loops of bowel with or without gas-fluid levels, plus the gas bubble appearance as described by Neuhauser, can be taken to indicate meconium ileus in the newborn.—*Z. Petrany, M.D.*

Pannhorst, R. Funktionelle Röntgenzeichen am Dünndarm bei epidemischer Parotitis. (Functional roentgen signs of small bowel in epidemic parotitis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, Sept., 1957, *87*, 329–334. (Address: Rudolf-Virchow-Krankenhuas, Augustenburger Platz 1, Berlin N 65, Germany.)

The involvement of pancreas in mumps is a clinically established fact.

Of an unknown number of patients with epidemic parotitis, two cases are discussed in more detail and their roentgenograms reproduced. Gastrointestinal series were performed a week or more after onset of the disease.

The first patient, a twelve-year-old child, exhibited a painful swelling of the left parotid, fever up to 102° F., vomiting, headache, and had signs of spinal rigidity during the initial phase of disease. Two spot roentgenograms of the duodenal bulb and of the duodenal loop are included, one of which shows an undifferentiated, band-like barium stream through the second portion of the duodenum, giving a "watering can" appearence.

The second, also a twelve-year-old child, had similar symptoms but no nuchal rigidity. The roentgen examination one week after the onset of the disease, with temperature still at 100° F., revealed increased secretions in the stomach, widening and blurring of the duodenal folds, and marked inconsistency in tonus of the duodenal loop. There were also disturbances in tonus of the jejunum and ileum with wide segmentation and hypersecretion.

These two cases are used as the basis for discussion of "functional" pancreatic disturbances during parotitis. The "watering can" appearance of the barium distribution in the duodenum is discussed at length. It is believed to be produced by combined changes in tonus, secretions, and motor function of the duodenum and is seen in gallbladder disease as well but most frequently in acute pancreatitis. The author is inclined to regard the described findings as supportive evidence of pancreatitis. Neither the local findings on physical examination nor results of laboratory data (amylase) are mentioned in the report.—*Nathan Kriss, M.D.*

Rohrs, Lloyd C. Intestinal polyposis and pigmented spots of lips; hereditary Peutz-Jeghers syndrome. *J.A.M.A.*, Sept. 21, 1957, *165*, 208–210. (From: The Medical Service, United States Naval Hospital, Oakland, Calif.)

The author gives a detailed history of the forty-ninth surgically proved case of intestinal polyposis and pigmented spots of the lips. The reported patient showed the usual vague and acute episodes of abdominal pain. Melanin spots were limited to the vermillion border of the lips and extended into the labial mucous membranes. Polyps were found at various times in the small bowel and colon. Two of these polyps were malignant. Intussusception occurred twice. A questionable hereditary history was obtained.—*George A. Miller, M.D.*

Stamatakos, Michael J., and Taber, Kenneth W. Oral cholangiography; preliminary report. *J.A.M.A.*, Aug. 17, 1957, *164*, 1752–1755. (Address: K. W. Taber, 421 Chew St., Allentown, Pa.)

Oral cholecystography (telepaque) was done on 724 patients who had not had their gallbladders removed. In the patients with nonvisualization of the gallbladder, the common duct was visualized or the patient showed clinical evidence of liver or common bile duct disease except in 4 cases. In 3 cases, no clinical examination was made for evidence of liver or common duct disease. In the other case, pyloric obstruction was present. Two patients with clinical evidence of liver disease showed common duct visualization.

The usual routine for oral cholecystography was followed including "reinforcement" and examination twenty-four hours after the first study.

The authors have been able to demonstrate calculi in ducts visualized and feel that with further perfection of their technique, a new method may be added to gastrointestinal studies.—*George A. Miller, M.D.*

MacCarty, W. C., Jr., and Crickard, G. E. Operative cholangiography. *Radiology*, August, 1957, *69*, 236–239. (Address: W. C. MacCarty, Jr., Mary Hitchcock Memorial Hospital, Hanover, N. H.)

This paper is based on a study of 180 operative cholangiographies performed during the years 1950 to 1955 inclusive at the Mary Hitchcock Memorial Hospital, Hanover, N. H. It was found that the percentage of unsatisfactory examinations and errors in interpretation decreased as experience with the technique increased. A correct diagnosis was obtained in 70 per cent of the total series with an 82 per cent accuracy found during the last year.

The objectives of this procedure are as follows: (1) to avoid unnecessary common duct surgery, particularly in poor risk patients; (2) to check the ducts after choledochostomy, before closing the abdomen; (3) to serve as a pre-exploration map to reveal congenital anomalies in the duct system; (4) to detect residual stones, cystic duct stumps, and pancreatic duct abnormalities in patients undergoing an exploration for postcholecystectomy bile duct symptoms.

The authors feel that, with improvements in technique and added confidence in the procedure, a majority of unnecessary common duct explorations may be avoided.—*Donald N. Dysart, M.D.*

McCabe, Edward B., and Heinrich, Ward D. The importance of visualization of the proximal portion of the common duct and hepatic ducts in operative cholangiography. *Radiology*, August, 1957, *69*, 240–243. (Address: E. B. McCabe, 13951 Terrace Road, East Cleveland 12, Ohio.)

Operative cholangiography is usually performed to determine the presence or absence of residual calculi, tumor, stricture, or other disease of the distal common duct. The purpose of this article is to stress the importance of determining the normalcy of the proximal portions of the common duct and the hepatic ducts.

In order for operative cholangiography to be of value certain factors should be present: (1) Good diagnostic cholangiograms must be available—proper positioning and a preliminary scout roentgenogram will insure this; (2) a radiologist should be in the operating room to interpret the films immediately; (3) since there is no contraindication to immediate repetition of the examination this should be done if the films are of poor quality; (4) visualization of both the common duct proximal to the cystic duct and the hepatic ducts is most important in determining whether residual stones, tumor or other pathologic conditions are present.

Four cases are presented which emphasize the above points and illustrate some of the conditions which may exist.—*Donald N. Dysart, M.D.*

Genitourinary System

Woolley, Ivan M., Keizur, Lowell W., and Mayer-Harnisch, Guenther. Gallbladder visualization following the use of 70 per cent sodium acetrizoate (urokon sodium) for intravenous pyelography. *Radiology*, Oct., 1957, *69*, 576–577. (Address: I. V. Woolley, Emanuel Hospital, 2801 N. Gantenbein Ave., Portland 12, Ore.)

The authors report the results of studies to determine the frequency of gallbladder visualization following the use of 70 per cent sodium acetrizoate (urokon sodium) for intravenous pyelography. Twenty-five consecutive patients undergoing excretory urographic studies were examined roentgenographically two hours after having received standard doses of urokon sodium 70 per cent. Twelve of the 25 showed some degree of opacification of the gallbladder. In 5 of the 12, the gallbladder shadow was graded as clearly visible.—*Arno W. Sommer, M.D.*

Zollinger, H. U. Thorotrastschädigung der Nieren mit Hypertonie. (Thorotrast damage of kidneys associated with hypertension.) *Schweiz. med. Wchnschr.*, Aug., 1957, *87*, 1089–1091. (From: Patholog. Institut des Kantonsspitals, St. Gallen, Switzerland.)

Thorotrast was introduced as a contrast medium for retrograde pyelography twenty-five years ago but was gradually withdrawn from use a few years later due to the recognized delayed harmful radioactive effects.

In retrograde pyelography the deposits of thorotrast were found mainly in perihilar fat tissue of the kidneys and in the perivascular structures leading to severe sclerosis of the connective tissue and vessels. In cases in which the material was introduced with greater pressure the kidney parenchyma itself became involved with distribution along lymph- and blood vessels.

In the presented case a bilateral retrograde pyelography was performed in 1938 with undiluted thorotrast on a then thirty-four year old female patient. Eleven years later she developed hypertension which was temporarily relieved by right nephrectomy, although the other kidney contained visible opaque speckled deposits in the renal pelvis and upper pole.

Seven illustrations are included showing, among others, an autoradiogram of the removed right kidney with subpelvic and parenchymal accumulation of thorotrast. The photomicrograph shows thorotrast deposits in the stroma, degeneration of tubules and sclerosis of glomeruli with thickened capillaries.

The hypertension is believed to be of renal origin due to decreased blood supply by perivascular granulomas and damage to the arterioles.—*Nathan Kriss, M.D.*

Ganem, Emil J., Calitri, Joseph, and Glidden, H. Spencer. The roentgenographic diagnosis of cystitis emphysematosa. *J. Urol.*, Sept., 1957, *78*, 245–251. (Address: E. J. Ganem, 301 Essex St., Lawrence, Mass.)

Cystitis emphysematosa may be defined as an inflammatory condition of the urinary bladder associated with the presence of gas vesicles in the bladder wall, usually produced by gas forming bacteria of the

colon group and frequently seen in patients with diabetes mellitus or hyperglycemia.

Although this condition has been known since 1926, the first mention of roentgen diagnosis appeared in the literature in 1934 following an oxygen cystography which depicted a swollen bladder wall with rarefied areas. The authors review the literature and quote the findings as described in the different articles. The diagnosis has been made on plain roentgenograms of the abdomen, excretory urograms, and retrograde cystograms.

It is thought by some that the gas production of the bacteria, which are supposed to be the etiologic agent in cystitis emphysematosa, is of a transient nature depending on the stage of inflammation of the bladder wall. They think this is due to the infrequency of cystitis emphysematosa in proportion to the high incidence of colon bacteria cystitis in general. Therefore, the roentgen appearance varies according to the stage of the disease.

Boijsen and Lewis-Johnson divide the disease into three stages depending on the roentgen appearance. (*Acta radiol.* 1954, 41, 269.)

Stage 1: A clear zone 1 mm. wide seen around the contrast medium. There is no free gas in the lumen of the bladder at this time.

Stage 2: An irregular swollen thick bladder wall with large gaseous vesicles intramurally. At this time there is no pneumaturia.

Stage 3: The vesicles have ruptured and free gas appears in the lumen of the bladder and gradually decreases from this time on. The length of these stages is not definitely known; however, it is thought that it depends upon the duration of the infection and the rapidity with which the infection is brought under control.

The authors report 2 cases with roentgenologic and pathologic findings. In their first case a radiolucent ring shadow in the region or the bladder was demonstrated on the intravenous pyelograms. This disappeared four days later. The second case revealed a large gas filled area in the region of the bladder on a survey roentgenogram of the abdomen. Gas was noted to escape through the cystoscope at the time of direct examination. Both patients were diabetics who responded through regulation of their diabetes plus the clearing of the urinary infection with the aid of antibiotics. Four illustrations are included.—*George W. Chamberlin, M.D.*

Atkins, Harold L., and Hodes, Philip J. The use of oral antihistamines in intravenous urography. *Radiology*, Sept., 1957, *69*, 384–388. (Address: H. L. Atkins, Department of Radiology, Grace-New Haven Community Hospital, New Haven, Conn.)

The authors report on a study on the use of orally administered antihistamines prior to intravenous urography in an attempt to reduce undesirable side effects. In this study, 1,580 examinations were carried out using 50 per cent neo-iopax as the contrast medium and six different antihistamines which were administered the evening before and one hour prior to the examination. There were two control groups, one given placebos and the other given nothing; these were then compared with the six antihistamine groups. Reactions were evaluated as to nausea and vomiting, flushing, venospasm, asthma, urticaria, syncope, and shock. There were no deaths.

The results obtained revealed no significant difference in the number or severity of reactions between the control groups and the groups premedicated with antihistamines. The authors conclude that the routine use of orally administered antihistamines is not beneficial in intravenous urography.—*John S. Alexander, M.D.*

Mishalany, Henry G., and Gilbert, Donald R. Benign ossified lesion of the kidney—report of a case resembling a hydatid cyst. *J. Urol.*, Oct., 1957, *78*, 330–336. (From: The Urological Service, Memorial Hospital, Charleston, W. Va.)

The occurrence of bone in benign lesions of the kidney is rare; however, it is well known that heterotopic bone formation may take place in any tissues containing long-standing deposits of calcium. The ossification is different from a diffuse calcium deposition in organs due to systemic imbalance in the calcium and phosphorus metabolism. The exact process of bone formation in tissues is unknown. The most plausible theory is that fibroblasts revert to osteoblasts under certain conditions and thus form true bone. Bone formation in malignant lesions of the kidney is uncommon.

Benign osteomas of the kidney present themselves as round tumors causing a bulge under the capsule of the kidney from which they arise. Bony tumors may also result from organization of blood and urine following trauma or infection.

Ossified endotheliomas of the kidney have been described. The experimental ligation of the renal vessels has produced bone in the kidney. Osseous metaplasia of the pelvic epithelium has also been associated with renal calculi. There have been cases reported of bone in the dermoid cysts and solitary cysts of the kidney.

Renal hydatid cysts contain calcium in the cyst wall; however, no cases have been reported in this country of bone formation in the hydatid cysts. The authors herein present a case of a young, white female who had a nephrectomy which showed a solitary ossified cyst of the kidney resembling a hydatid Echinococcus cyst. They state that the exact etiology is unknown due to the rarity of hydatid cysts in the United States and the inability to make a conclusive microscopic diagnosis. Reproductions of intravenous urograms and photographs of the specimen are included.—*George W. Chamberlin, M.D.*

Dean, Archie L., Jr., Lattimer, John K., and McCoy, Cornelia B. The standardized Columbia University cystogram. *J. Urol.*, Nov., 1957, *78*, 662–668. (From: The Squier Urological Clinic, Columbia University, The Presbyterian and Babies Hospitals, New York 32, N. Y.)

Cystograms are frequently taken before and after treatment for evaluation of results in children with dilated urinary tracts. The authors state that if the technique used at each examination is not identical, the comparison of the cystograms is not valid. They describe their standardized technique which has been used in over 100 examinations without untoward reactions.

The urethral catheter is inserted into the bladder before the child is transported to the Radiology Department. The medium consists of 60 cc. of 50 per cent hypaque mixed with 200 cc. of sterile isotonic saline. This solution is hung in a flask 24 inches above the symphysis pubis of the patient. Five hundred milligrams of neomycin are injected into the tubing to prevent febrile reactions following which the mixture is allowed to drop at the rate of 120 drops per minute. When the intrarenal pressure increases to a point when the fluid stops dropping, a roentgenogram is made. If vesicoureteral reflux is noted, the urethral catheter is drained for ten minutes and a second roentgenogram is made. If residual medium is still present, additional films are exposed to determine the time required for complete evacuation. If no reflux is noted on the first film, the catheter is clamped for thirty minutes and a repeat roentgenogram is obtained; another one is obtained following voiding. The authors present a table outlining the method described. Four case reports are presented with the roentgenologic findings.

The authors believe that cystograms are of great importance in the treatment of chronic urinary tract disease in children. A cystogram not only discloses vesicoureteral regurgitation, but also demonstrates areas of incomplete drainage. A method used in older children and adults is a triple voiding technique which reveals ureteral retention or "trapping." Still more information may be obtained by the addition of new techniques and the application of special techniques in individual cases.

A plea is made for other physicians to adopt standardized cystographic techniques in order that comparison from different institutions might be of value. Six illustrations and one table are included.—*George W. Chamberlin, M.D.*

Rothfeld, Samuel H., and Epstein, Bernard S. The size of the bladder on intravenous urography and retrograde cystography; a potential source of diagnostic error in children. *J. Urol.*, Dec., 1957, *78*, 817–820. (From: The Departments of Urology and Radiology, The Long Island Jewish Hospital, New Hyde Park, N. Y.)

This article deals with the study of children who were found to have dilated bladders on routine intravenous pyelography and retrograde cystography when further investigation failed to reveal any basis for the distention of the bladder. The authors attempt to establish criteria for the normal bladder and the deviations of the normal bladder.

Two cases representative of these studies are presented. The first is that of a ten year old white girl who had frequency and pyuria. Organic neurologic disease had been ruled out. A cystometric curve and the cystograms are reproduced. Cystoscopy revealed no bladder neck obstruction. The second case is that of an eight year old white girl, with the clinical diagnosis of pyelonephritis. Intravenous urography was negative. The bladder was considered to be dilated. A cystometrogram and the roentgenograms of the bladder of this case are also reproduced.

The authors quote Campbell, who found that the initial desire of a child to void occurs when the bladder contains a volume of 80 to 100 cc. of fluid and the capacity of the bladder is approximately 100 per cent greater than the volume. In the 2 cases cited the desire to void occurred with a volume of 200 cc. and a pressure of 7 to 10 cm. H_2O. The bladder outlines in the cystograms were symmetric and smooth, in contrast to those found in abnormal bladders where there is noted irregularity, thickened trabeculations and asymmetry.

The embryology of the bladder is briefly reviewed. The statement is made that at the age of ten years the process of the bladder "dropping" into the pelvis is not yet complete. This results in relative disproportion between the size of the bony pelvis and the full bladder. The authors believe that an apparent dilatation of the distended bladder is not of pathologic significance in a child when the enlargement is symmetric and the longitudinal axis is the greatest. —*George W. Chamberlin, M.D.*

Baskin, Arnold M., Harvard, B. Marvin, and Janzen, Arnold H. Sterile fluoroscopy: Preliminary report of a new technique for localization of renal calculi. *J. Urol.*, Dec., 1957, *78*, 821–826. (From: The Departments of Urology and Radiology, Yale University School of Medicine and Grace-New Haven Community Hospital, New Haven, Conn.)

The localization of renal calculi at operation has been the cause of much difficulty among urologists for many years. The various methods used for this purpose are summarized and their deficiencies indicated. The first use of fluoroscopy in 1919, for localization of stones is described and its inadequacies noted. The size of the machinery was cumbersome and the distortion of the image due to the long object-screen distance, plus the radiation hazards and

the inability to continue the operation simultaneously, were great disadvantages.

In this article a new technique of sterile fluoroscopy is described. A small fluoroscopic screen enclosed in transparent plastic is sterilized and placed in the wound adjacent to the kidney. A sterile roentgenographic cone is attached to a portable roentgen-ray machine and when the room is darkened, the surgeon is able to localize the calculus by direct vision. The screen used by the authors measured $10\times7\frac{1}{2}\times1\frac{1}{2}$ cm. and had rounded edges to protect the tissues from trauma. Sterilization was done by immersion in zephiran for twenty minutes. A diagram of the cone for the portable unit is presented along with a lead diaphragm to control the size of the beam. A standard Picker portable apparatus was used, operating at 60–80 kv. peak and 1–2 ma. With a focal spot to target distance of 30 inches stones as small as 0.25 cm. could be visualized.

The radiation hazard to personnel is discussed. When the screen intercepted the entire beam, the readings behind the glass were 0 mr per minute. Diagrams are presented, showing the scattered radiation when the extension cone was used and when the entire beam was intercepted by the kidney. The hands of the physician should be at least 6 inches from the kidney.

The greatest hazard of this method lies in the fact that the entire roentgen ray beam may not be intercepted by the lead glass screen. It is absolutely necessary to have an accurate beam limiting cone, and proper alignment of cone and screen.

The disadvantages of the procedure are: (1) The lights in the operating room must be turned off to obtain maximum contrast and dark adaptation is necessary; (2) one member of the surgical team should be adapted to the dark beforehand, so that no time will be lost in the operation; and (3) because of the use of electrical instruments in an explosive atmosphere, cooperation of the anesthetist must be obtained.

The authors conclude that this new technique for the localization of renal calculi in the operating room is promising. One photograph and two diagrams are included.—*George W. Chamberlin, M.D.*

Skeletal System

Heller, J. H., König, H., and Fox, L. A method for quantitative *in vivo* measurement of the rate of bone healing beginning shortly after the production of a lesion. *Surg., Gynec. & Obst.*, Dec., 1957, *105*, 722–726. (From: The Divisions of Physics and Experimental Surgery, New England Institute for Medical Research, Ridgefield, Conn.)

The healing of fractures and the take of bone transplants have been studied in the past by clinical and roentgenographic evaluation and by animal sacrifice and histologic evaluation. However, a good quantitative method was not available until the isotope of strontium (Sr^{85}) was produced in the cyclotron. Sr^{85} is a bone seeker like calcium and is a pure gamma emitter of 0.51 mev. energy. It has a half-life of sixty-five days. Sr^{90} has a half-life of twenty-eight years and is not used.

The present study was done on albino rats. Five microcuries of a buffered $Sr^{85}Cl$ solution was found to be effective and was injected subcutaneously. The radioactive uptake and content of specific sites in both tibias and femurs were measured in each animal for several days prior to the induction of a fracture in one of the tibias. After the fracture was induced, the radioactive uptakes at the fracture site, the opposite tibia and both femurs were measured. The study was carried on until healing took place. The data obtained were corrected for decay and excretion and plotted on graphs to show the per cent change in uptake of Sr^{85}. The uptake and content of Sr^{85} was shown to increase in the fracture site and decrease in the adjoining femur.

The above technique can be used to study the effects of vitamins, endocrine and various synthetic therapeutic agents on deposition of Sr^{85} in fracture sites and also to study factors regarding the take of Sr^{85} containing bone transplants and grafts. Other bone disease can also be studied.

Calcium and strontium do not have exactly equal dynamics. In the future Ca^{47} may be used if it can be produced successfully. It has a half-life of 4.7 days.—*Charles W. Cooley, M.D.*

Keats, Theodore E. Diffuse thickening of the calvarium in osteogenesis imperfecta. *Radiology*, Sept., 1957, *69*, 408–411. (Address: University School of Medicine, Columbia, Mo.)

An unusual case of osteogenesis imperfecta in a 28 year old white female is reported. There was a history of repeated fractures following mild trauma and difficulty with hearing since the age of thirteen. Two older brothers and her father were known to have "soft" bones with a similar history of multiple fractures and hearing defects. They also had blue sclera. On physical examination the patient was found to have a large head, partial deafness and blue sclera. The Sulkowitch test was 3 plus. The roentgen findings were unusual in several respects. The skull was large and granular, showing marked thickening of the frontal, parietal and occipital bones, due to thickening of the diploic space. The remaining bones showed rather marked osteoporosis, without the thinned cortices and slender shafts of the classical form.

Thickening of the calvarium is a rare finding in this disease. In a similar case previously reported by Bakwin and Eiger the diagnosis of osteogenesis imperfecta was excluded partly on this finding. The author emphasizes however, that thickening of the calvarium does not exclude the diagnosis of osteo-

genesis imperfecta. The case also illustrates a form of osteogenesis imperfecta characterized only by osteoporosis, without slender shafts and thinning of the cortices.—*Z. Petrany, M.D.*

Bersani, Frank A., and Samilson, Robert L. Massive familial tarsal synostosis. *J. Bone & Joint Surg.*, Oct., 1957, *39-A*, 1187–1190. (From: The New York Orthopaedic Hospital, Columbia-Presbyterian Medical Center, New York, N. Y.)

Massive tarsal synostosis, bilateral and present in 3 patients in 2 generations, is fully documented. Various combinations of fusion of the tarsal bones have been reported previously, but none as extensive as these.

The mother, her son and daughter all had bilateral congenital synostosis of the talus, navicular, cuboid, second and third cuneiforms and second, third and fourth metatarsals. They had pain and fatigue. No weight-bearing was performed by the first metatarsal head; there was supination of the forefoot and plantar flexion of the outer 4 metatarsals.

The eight year old boy had bilateral midtarsal osteotomies with correction of the supination deformity; twelve year follow-up showed no pain. The fourteen year old girl had similar surgery with only occasional ache in one foot four months later.—*Martha Mottram, M.D.*

Greenberg, Benjamin E., and Street, Dana M. Idiopathic non-familial acro-osteolysis; report of a case observed for five years. *Radiology*, August, 1957, *69*, 259–262. (Address: B. E. Greenberg, VA Hospital, Park Ave. and Getwell St., Memphis 15, Tenn.)

The authors present an unusual case of multiple lytic and cystic lesions in the tubular bones of the hands and feet together with an area of rarefaction in the mandible and a tendency to slow progression. The case is similar to one reported by Harnasch in 1950 and described by him as acro-osteolysis. The fingers and toes were clubbed in this patient and roentgenograms revealed bilateral cystic changes in the heads of both first metatarsal bones and the fourth left metatarsal bone. Osteolytic defects in the distal articular ends of the middle phalanges of the right second and third toes and the left second and fourth toes were also present. In the hands there were defects of the shafts of all the terminal phalanges except that of the right thumb. The mandible contained an area of rarefaction in the horizontal ramus on the right side. There were no concomitant laboratory findings or family history of import. A biopsy of an old fracture site of the fifth right metatarsal disclosed only nonspecific fibrosis. Follow up studies over a five year period revealed an increase in bone absorption in the head of the fourth metatarsal and erosion of the proximal end of the proximal phalanx of the fourth toe.

The case presented is one of only 3 similar cases in the literature which the authors consider to be idiopathic acro-osteolysis perhaps due to a developmental or congenital osseous dysplasia related to failure of ossification of the shafts of the small bones.—*John S. Alexander, M.D.*

Rotenberg, C., and McGee, A. R. (Toronto, Ontario, Canada.) Late bone changes in caisson disease; with a case report. *J. Canad. A. Radiologists*, Sept., 1957, *8*, 50–53.

Caisson disease following a rapid decrease in atmospheric pressure affects individuals in varying degrees, depending upon several factors including the amount of the pressure change, the percentage of nitrogen in the surrounding atmosphere and the body habitus.

The severity of the disease depends principally upon the organs involved. It may be fatal through changes in the circulatory system and the blood has been described as having a frothy appearance at autopsy. Varying degrees of paralysis may be produced by infarction of the brain or spinal cord.

The changes roentgenographically are seen in the long bones and occur later in the course of the disease. Early bone changes have been described about two to five years following an accident.

Bone infarcts are frequently symmetric and may be found in the epiphyses and near the ends of the shafts of the long bones.

Epiphyseal infarcts appear as wedge-shaped densities extending to the joint surfaces and may give the appearance of aseptic necrosis and go on to secondary arthritic changes.

The diaphyseal infarcts involve the medulla and present a fairly characteristic appearance of irregular calcifications appearing in threads, chains, or clusters.

The authors report a case with quite typical changes involving the shoulders, a hip, and both femora and tibiae. These developed following a single exposure about twenty-five years prior to the present changes.—*George L. Sackett, Jr., M.D.*

Carroll, David S. Roentgen manifestations of sickle cell disease. *South. M. J.*, Dec., 1957, *50*, 1486–1490. (From: The Departments of Radiology of the University of Tennessee College of Medicine and the City of Memphis Hospitals, Memphis, Tenn.)

The roentgen manifestations in 124 cases of sickle cell disease are analyzed. The roentgen changes in bone are due to 2 fundamental processes. The first is that of marrow hyperplasia, which is an effort on the part of the body to compensate for the severe protracted anemia. This is most evident in flat bones.

The second is that of a thrombotic phenomenon, which is predominant in long bones.

Hyperplastic bone marrow is manifested by decalcification of the bone and thinning of the cortex, with or without coarsening of the architecture. These changes are uncommon in the long bones, occurring in only 4 of the 124 cases. In the spine and pelvis, abnormalities due to hyperplastic bone marrow are common. There is a coarsening of the architecture and loss of structural strength. Thirty per cent of the cases showed biconcavity of the vertebral bodies.

Abnormalities due to thromboses in bone were present in about 50 per cent of patients. The general reaction of a long bone to hypoxia is that of thickening of the cortex and narrowing of the medullary cavity. This is commonly seen in sickle cell disease. In addition, localized areas of thrombosis may become densely calcified or less commonly may appear in bizarre forms if the necrotic bone is replaced by hyaline or fibrous tissue. Aseptic necrosis of an entire ossification center is common, occurring in 10 per cent of the patients.

In 9 patients there were multiple small overcalcified areas in the ribs, vertebrae, and pelvis which resembled osteoblastic metastases. These are presumably secondary to thrombosis.

In the skull roentgen manifestations are variable. In 20 patients there was thickening of the calvarium. In 9 patients there were multiple radiolucencies which resembled the lesions of multiple myeloma to a remarkable degree. These areas are thought to represent fibrosis following thrombosis. Seven patients showed thickening of the calvarium with perpendicular striations giving a "hair-on-end" appearance.

Seven patients had sickle cell dactylitis consisting of periosteal proliferation and cyst-like areas of bone destruction in some of the metatarsals, metacarpals, and phalanges.

Four patients had a Salmonella osteomyelitis with involvement of multiple bones. The author believes that this high incidence of Salmonella osteomyelitis might be due to thromboses in the wall of the intestine which allow enteric organisms to enter the blood stream.

Cardiac enlargement was the most common single roentgen finding in sickle cell disease.

The author concludes that the roentgen manifestations of sickle cell disease are so protean that differential diagnosis may be quite difficult. His 5 interesting illustrations certainly support this conclusion.—*J. L. Williams, M.D.*

Meyer, George A., Stein, Joseph, and Poppel, Maxwell H. Rapid osseous changes in syringomyelia. *Radiology*, Sept., 1957, *69*, 415–418. (Address: G. A. Meyer, VA Hospital, 130 W. Kingsbridge Road, Bronx 68, N. Y.)

Neuropathic arthropathies occur as a result of repeated injuries to articulations in which sensory perception is diminished. The following changes are seen: enlargement of the joint due to effusion; relaxation of the ligaments with subsequent instability and deformity; thinning of articular cartilage; marginal fractures; condensation of subchondral bone; loose bodies in the joints; formation of new bone outside the joint cavity. Clinically, arthropathies develop in 25 per cent of cases of syringomyelia, and 80 per cent of syringomyelia arthropathies involve the upper extremity. Cases of syringomyelia have been described in which joint changes developed within a relatively short time.

The authors present the report of a case of syringomyelia accompanied by rapidly progressive bone changes. In less than two and a half months, degenerative changes had progressed from minimal erosive changes involving the greater tuberosity of the humerus to complete absorption of the major portion of the anatomic neck of the humerus. Two years later there was complete disorganization of the head of the humerus and the glenoid process of the scapula, with extensive fragmentation of bone into the soft tissues and eburnation of the adjacent bone surfaces.—*Arno W. Sommer, M.D.*

Gramiak, Raymond, Ruiz, Gilberto, and Campeti, Frank L. Cystic angiomatosis of bone. *Radiology*, Sept., 1957, *69*, 347–353. (Address: R. Gramiak, 277 Alexander St., Rochester, N. Y.)

The classic appearance of cavernous hemangioma of bone is well known. The authors describe and give a case report of a rare and somewhat atypical form of cavernous hemangioma, labeled "cystic angiomatosis." Roentgen studies showed widespread distribution of purely cystic lesions, which showed none of the usual roentgen findings associated with hemangioma of the vertebrae or flat bones. The lesions in the long bones also were not entirely typical.

The cystic lesions may be distributed in any or all bones and also in the viscera. The definite diagnosis is made by biopsy of an involved rib, as biopsy of other bones is difficult because of bleeding. Pathologic studies show the cavernous type of hemangioma most commonly, with the capillary type being exceedingly rare.

Roentgenographically the lesions have an identical appearance, regardless of the bone involved. The rounded cystic spaces show no evidence of fibrillation or trabeculation. Individual lesions may be unilocular or multilocular and vary in diameter from a few millimeters to several centimeters. Each is ringed by a sharply demarcated rim of sclerotic bone and there may be a local increase in bone density. There is no reactive bone formation or periosteal elevation. The lesions may be in the epiphysis, metaphysis or diaphysis, in the cortex or spongiosa. The epiphyseal cartilage is not involved. Fractures through the cysts may occur and produce bone deformity.

Deep roentgen therapy has been recommended for

the deep-seated hemangiomas since surgery may be difficult and dangerous. Depth doses of approximately 3,000 r delivered in from three to nineteen weeks have been given. The prognosis is not known because of the limited number of cases.—*Donald N. Dysart, M.D.*

Porretta, Charles A., Dahlin, David C., and Janes, Joseph M. Sarcoma in Paget's disease of bone. *J. Bone & Joint Surg.*, Dec., 1957, *39-A*, 1314–1329. (From: The Section of Surgical Pathology and the Section of Orthopaedic Surgery, Mayo Clinic and Mayo Foundation, Rochester, Minn.)

The authors report 16 cases of osteogenic sarcoma which occurred among 1,753 examples of Paget's disease of bone, an incidence of 0.9 per cent. The age of these patients with sarcoma varied from thirty-two to seventy-two years, the median being fifty-nine years. The sex incidence was approximately 2 men to 1 woman. Severe local pain was present in each case of sarcoma except one, and all cases with sarcoma had palpable tumor masses. Roentgenograms alone could not be depended on to make the diagnosis, as the protean manifestations of Paget's disease tended to mask the evidence of sarcoma. However, in patients with recent onset of pain, swelling or both, roentgenograms were important in locating suspicious areas for biopsy specimens. Three of the sarcomata were osteoblastic and 13 were osteolytic.

In 2 of the authors' cases, sarcoma developed at the sites of previous pathologic fractures through bone affected by Paget's disease. Although sarcoma may be secondary to fracture in some cases, it cannot be proven that fracture does not take place through bone affected by preclinical sarcoma. Consequently, if such a fracture occurs, the clinician should be alerted to the possibility that sarcoma may develop soon.

Ten of the sarcomata in this series were examined microscopically and each was an osteogenic sarcoma. All 16 patients died from the sarcoma in spite of amputation and roentgen therapy. Five had pulmonary metastases when they were first seen. Delay in diagnosis and treatment is considered to be one of the factors in the poor prognosis.—*Arthur E. Childe, M.D.*

Kernwein, Graham A., Roseberg, Bertil, and Sneed, William R., Jr. Arthrographic studies of the shoulder joint. *J. Bone & Joint Surg.*, Dec., 1957, *39-A*, 1267–1279. (From: The Rockford Memorial Hospital, Rockford, Ill.)

Contrast arthrograms were made of 96 shoulders and 54 of these subsequently had surgery. Twenty cc. of 35 per cent diodrast with 20 cc. of distilled water were injected into the joint just below the coracoid process. When 40 cc. has been injected or when there was definite resistance, 10 to 20 cc. of filtered air were injected. The authors had no complications. The diodrast absorbed in two to three hours and the tissues later removed surgically showed no microscopic change.

Normally the capsule balloons out with a small pouch at the neck medially and a smooth margin at the anatomic neck. The subscapular bursa fills. There is no communication with the subacromial bursa. The capsule extends 2 inches down the intertubercular groove and the biceps tendon is visualized. An adult joint holds about 20 cc. The only difference between a child and adult shoulder joint is the capacity. Fourteen of 26 patients with these normal findings had surgery and the arthrographic findings were confirmed.

With a complete rupture of the rotator cuff, there is extension of the diodrast into the subacromial bursa and the capacity of the joint is increased. Forty-six cases had these changes and surgery was done on 35, with confirmation of the diagnosis in 33. One of the errors was apparently due to escape of the diodrast through a fracture line into the subacromial bursa.

In incomplete rupture, there is interruption of the sharply defined line of the capsule in the region of the neck with an ulcer-like crater; the volume is unaltered.

Although complete rupture of the long head of the biceps is recognized clinically, an association lesion in the rotator cuff may be shown arthrographically. Complete dislocation of the tendon of the long head of the biceps with rupture of the cuff was found unexpectedly at surgery in 8 cases, and, although, the bicipital pouch may be outside the groove, there may be no arthrographic evidence of tendon dislocation.

The presence of calcium in the subacromial bursa does not preclude the possibility of an additional lesion. Seven out of 12 patients with calcium showed a rotator cuff tear arthrographically and 4 of these had confirmatory surgery.

Dislocation of the shoulder produced a tear in the capsule, increased capacity and enlargement of the subscapular bursa. There may be associated rotator cuff tear and filling of the subacromial bursa. The arthrographic findings were confirmed by surgery in 7 of 9 patients.

In capsulitis, there is a reduction in the fluid capacity and there is no communication between the joint and the subacromial bursa. There was a bicipital synovial pouch demonstrated in all 12 patients. Surgically, the capsule and coracohumeral ligament were markedly thickened and inelastic. There were no adhesions and the joint space was present.

Large tears in the rotator cuff may exist with normal or nearly normal range of shoulder motion; it is difficult to recognize these with certainty by the usual test. Range of motion is determined after local anesthetic. Problem shoulders can be classified into 4

groups: (1) Patients with normal active and passive motion and normal abduction strength. There is an occasional incomplete tear of the cuff in these patients (of 21 patients 3 showed this arthrographically). (2) Patients with normal active and passive motion and reduced abduction strength are problems in differentiating conditions with tears from those that have no tears but reduced strength tests. In these there is often complete rupture of the cuff (37 shown arthrographically in 43 cases). (3) Similar to group 2, but with reduced active motion. There is often complete rupture of the cuff (9 shown arthrographically in 11 cases). (4) Patients with reduced active and passive motion and reduced abduction strength tests (none of these showed ruptures out of 12 cases).

In the hands of Kernwein, Roseberg and Sneed this examination and classification has proved accurate and extremely useful.—*Martha Mottram, M.D.*

Blood and Lymph System

Massell, Theodore B., Greenstone, S. M., and Heringman, E. Craig. Evaluation of diatrizoate (hypaque) in peripheral angiography and aortography. *J.A.M.A.*, Aug. 17, 1957, *164*, 1749–1752. (Address: T. B. Massell, 6317 Wilshire Blvd., Los Angeles 48, Calif.)

The authors performed vascular studies in 83 patients using the sodium salt of diatrizoate and a 2 to 1 mixture of methylglucamine and sodium salts of diatrizoate (42 phlebographies, 28 peripheral arteriographies, and 13 aortographies). In comparison with other commonly used organic iodine compounds, the authors felt that diatrizoate (hypaque) produced considerably less untoward local and general reactions. The mixture of methylglucamine and the sodium salt of diatrizoate seemed to give even less reactions and better opacification. The direct toxic effects on the spinal cord and renal tissue have not been fully determined.—*George A. Miller, M.D.*

LaFia, David J., and Jaeger, Rudolph. Renografin as a new contrast medium for cerebral angiography; report of animal experiments. *Radiology*, Sept., 1957, *69*, 398–401. (Address: D. J. LaFia, Neurosurgical Research Laboratory, Jefferson Medical College, 1025 Walnut St., Philadelphia 7, Pa.)

Renografin, an organic iodide with 3 atoms of iodine in each molecule, was evaluated by the authors as a contrast agent in cerebral angiography in dogs. Renografin 60 per cent was injected in 5 cc. amounts for various totals from 15 cc. to 160 cc. in 12 dogs. Toxicity was evaluated on the basis of: (a) death of the animal; (b) fits; (c) break-down of the blood-brain barrier; and (d) irritation of the cortex and soft tissues. There was one animal death in the series but otherwise the side effects were considered minimal in the other dogs.

Renografin compared favorably as to radiopacity with thorotrast, hypaque 50 per cent, and diodrast 35 per cent which were used in cerebral angiographies on the same dogs. The authors conclude that renografin is a suitable contrast medium for use in cerebral angiography. It was found to be safe when injected in large amounts in dogs.—*John S. Alexander, M.D.*

Cooley, Robert N. Flow rates of contrast substances obtainable at conventional angiocardiography. *Radiology*, Sept., 1957, *69*, 402-407. (Address: University of Texas, Medical Branch, Galveston, Texas.)

The author reports on a study of certain factors that affect the velocity of injection of certain contrast media used in angiocardiography in adults. Flow rates were determined for urokon 70 per cent and miokon 90 per cent at temperatures from 78° to 120° F., with varying sizes of Robb cannulas and a Robb syringe.

It was found that strict adherence to a proper injection technique was of great importance in obtaining uniform rapid injections of the media. For adequate visualization an injection time of one and a quarter to one and a half seconds for 50 cc. of contrast substance through a No. 12 cannula will be satisfactory. Heating of the contrast media is necessary, particularly with the more concentrated substances, as this increases the flow rate and prevents the precipitations of crystalline substances.

Urokon 70 per cent at 105° F. will permit a satisfactory injection speed. Miokon 90 per cent at 105° F. will probably provide a satisfactory result. If heated, however, to a temperature of 120°, a more satisfactory flow rate is obtained, but this has not been tried yet in patients. Miokon 90 per cent is a more desirable medium as its side effects are considerably less pronounced than those of urokon 70 per cent.

The procedures and method of study are outlined.—*Donald N. Dysart, M.D.*

General

Kautzky, A. Zur Standardisierung der Röntgenaufnahme-Technik. (Contribution to standardization of the roentgenographic technique.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, Sept., 1957, *87*, 405–409. (Address: Auerspergstr. 9, Vienna 8, Austria.)

The formula of Biermann, van Dijck and van der Plaats $kv.^5 \times mas. = K$ provides a mathematical basis for calculation of a uniform quality technique regardless of the anatomic part. In a graph $kv.^5 \times mas.$ log product placed on the ordinate, the thickness of the

anatomic part in centimeters on the abscissa gives a linear relationship with parallel lines corresponding to increase in thickness. The author used $kv.^5 = 10^{-7} \times mas.$ on the ordinate in order to receive corresponding values in cm. on the abscissa. A sliderule carrying the mas. log product, $kv.^5 \times 10^{-7}$ and $kv.^5 \times mas.$ (in cm. projected on the ordinate) makes the calculation simpler.

The centimeter scale works well in homogeneous densities but requires reduction for thoracic spine and ribs because of air content in the lungs. The measurements of a particular anatomic part have to be taken at the same level and in the same position if equal quality is to be expected.—*Nathan Kriss, M.D.*

RADIATION THERAPY

Breed, J. Ernest. Radium treatment of cancer of the tongue. *Radiology*, August, 1957, *69*, 214–223. (Address: 59 East Madison St., Chicago 3, Ill.)

The author reviews the various therapeutic procedures used for the treatment of carcinoma of the tongue and describes his method of treatment. The results of the treatment of 100 consecutive unselected cases of cancer of the tongue, treated between 1933 and 1956, are presented.

Prior to the use of radium, a fair percentage of cures was obtained by means of surgery. Between the years 1915 and 1930 radium largely replaced surgery in the treatment of lingual cancer. Since the advent of antibiotics, lessening the probability of severe infection, renewed attempts have been made to attack this disease surgically.

The tongue is a primary site from which spread of cancer is very likely to occur. Lack of pain in the early stages of the disease makes early diagnosis relatively uncommon. A lesion which appears to be relatively small may be found to extend several centimeters under the adjacent normal mucous membrane. Metastases tend to occur early and may occur to almost any group of lymph nodes on either side of the neck.

All precautions, especially gentleness, are essential to prevent metastases. Rough handling of tissues may force clumps of malignant cells into the lymphatics. The author does not consider it advisable to remove chronically infected teeth before the cancer is treated. Even in taking a biopsy specimen he advises extreme care, and he sometimes delays taking a biopsy until after delivery of about 4,000 r to the surface of the tumor in cases which are obviously cancerous.

The author starts treatment with surface therapy by means of an applicator containing 500 mc of radon in glass tubes with silver jackets. Two mm. of silver surrounds the radon, with an additional 4 mm. of rubber to obtain distance. The applicator, at the end of a wire handle, two feet long, is applied to the surface of the lesion daily, for a total dose of about 6,000 gamma r delivered to the surface of the tumor. Radon seed implants are then inserted throughout the base of the tumor, using seeds with a strength of 0.5 mc placed about 6 mm. apart. The node-bearing region on the side of the lesion is treated with a radon bomb containing 500 to 1,000 mc of radon at a distance of 2 to 6 cm. A dose of about 5,000 gamma r is delivered to the lymph nodes in about one month. If palpable lymph nodes persist, a block dissection is performed.

One hundred cases of cancer of the tongue treated in this manner are reported. No attempt was made to stage these cases in various groups, beyond a simple classification of favorable or unfavorable. A case was considered unfavorable (a) if the growth was 4 cm. or over in its greatest diameter; (b) if the adjacent tissues were involved; (c) if evident metastases were present; (d) if previous treatment by surgery or irradiation had been given. All other cases were considered favorable. Of the favorable group 20, or 64.5 per cent were alive and free of disease after five years. Only five (1 per cent) of the patients in the unfavorable group were free of disease after five years.—*Arno W. Sommer, M.D.*

Bate, Doris, and Guttmann, Ruth J. Changes in lung and pleura following two-million-volt therapy for carcinoma of the breast. *Radiology*, Sept., 1957, *69*, 372–383. (Address: R. J. Guttmann, 99 Fort Washington Ave., New York 32, N. Y.)

A series of 50 patients treated on the 2-million-volt unit at the Francis Delafield Hospital (New York) between January, 1951 and January, 1956 were studied in order to determine the nature and incidence of postirradiation changes in the lungs and pleura. Two anterior fields were used, one covering the internal mammary lymph node chain and the other the supraclavicular and axillary areas. The tumor dose generally ranged from 3,000 to 5,000 r at the lymph node level, given in three to five weeks.

Thirty-five patients showed roentgen evidence of postirradiation changes in the lung while 5 patients had changes proved to be due to metastatic tumor. Subjective respiratory complaints due to irradiation were present in 7 patients. These consisted of a dry cough or dyspnea which responded to conservative treatment. Thoracentesis was performed in those cases where pleural effusion was present. A slight but definite increase in changes was noted with increasing tumor dose.

The authors stress the importance of recognizing these changes as being due to irradiation, since a correct interpretation of the roentgenologic findings may make the difference between proper conservative management of the symptoms and harmful further irradiation or ill-advised surgery. Adequate sequences of roentgenologic studies offer the chance

to make the correct diagnosis. The first change noted is a diffuse haze over the treated lung field which appears from a few weeks to a few months after conclusion of therapy. Following this, in one to three months, linear, fibrotic strand-like densities extending outward and upward from the hilus would be seen. This picture was usually accompanied by shrinkage of the upper lobe as evidenced by its smaller-than-normal size, deviation of the trachea to that side and elevation of the hilus and hemidiaphragm. Often the shrinkage and fibrosis would progress for several months and then remain stationary or resolve completely. Changes occurring outside the treated area or which, when in the treated area, showed increase in size usually proved to be due to metastases. —*Donald N. Dysart, M.D.*

KENNEDY, B. J. The present status of hormone therapy in advanced breast cancer. *Radiology*, Sept., 1957, *69*, 330–340. (Address: University of Minnesota Medical School, Minneapolis 14, Minn.)

Advanced breast cancer in the female has been shown to be altered in its growth characteristics by the use of hormones. A number of measures have been introduced to change the hormonal status of the patient so as to suppress or inhibit the hormonal factors which maintain tumor growth. Six major procedures have become established: (a) ovarian suppression (roentgen or surgical castration), (b) adrenal suppression (bilateral adrenalectomy), (c) pituitary suppression (surgical or roentgen ablation), (d) androgenic hormone administration, (e) estrogenic hormone administration, (f) adrenocortical hormone administration.

The choice and the sequence of treatment to be followed will depend mainly on the existing hormonal status of the patient. Accordingly, patients will fall into 2 categories, namely, premenopausal and postmenopausal.

Premenopausal Group: In premenopausal women with advanced breast cancer, estrogenic hormones have been proved to accelerate the cancer growth and spread. This is supported by the fact that castration in this period produces symptomatic improvement and objective regression of soft tissue and osseous lesions in 20 to 50 per cent of patients. Cancers which fail to respond to this procedure are considered not to be "hormone-dependent" and further efforts at changing hormonal balance will be useless. Knowledge of the response to castration in this group provides the best criteria for selection of patients for subsequent treatment with hormones, adrenalectomy and hypophysectomy. There is no proof however, at the present time, that prophylactic castration has any effect in delaying the onset of metastases or in prolonging the survival time of patients.

Bilateral adrenalectomy has been shown to produce changes similar to those following oophorectomy in hormone-dependent mammary cancer. The benefits are thought to be due to removal of another source of endogenous estrogenic hormone. Patients who failed to obtain benefit from castration also did not respond to adrenalectomy. Subjective and objective improvement have been found to occur in 45 to 65 per cent of patients with this procedure. Because of easier postoperative regulation, the author prefers hypophysectomy to adrenalectomy. Pituitary ablation, preferably surgical, will almost invariably produce a regression in these cancers which had previously responded to castration. Objective regression of lesions has been noted in as high as 65 per cent of selected cases. The main disadvantage is the technique of the surgery required.

The greatest benefit of androgens is in patients with bone metastasis, especially in postmenopausal patients. Their use in the premenopausal group is considered to be inferior to other measures such as castration, and they are employed in this group only after other procedures fail to control exacerbations of the disease. Furthermore, it has been shown, that 10 per cent of patients with osseous metastases develop an exacerbation of tumor growth following androgen therapy. Adrenal corticoids are indicated specifically in patients with severe hypercalcemia, convulsions due to cerebral metastases, and severe dyspnea due to pulmonary spread.

Postmenopausal Group: Estrogens have provided the longest remissions of any form of hormonal therapy in this group, and is the preferred method of treatment. Although the mode of action of estrogens in the postmenopausal women is uncertain, it has been demonstrated that approximately 50 per cent of patients with soft tissue lesions and 20 per cent with osseous lesions show objective improvement from such therapy. In patients with only osseous lesions, androgens are equally effective, but are much less so in producing regression of soft tissue metastases. In patients showing improvement on these hormones and who have recurrence of their disease, hypophysectomy will usually result in another remission.

To obtain maximum benefit and survival of the patient with advanced breast cancer, consideration of hormonal therapy should begin at the time the patient presents herself for initial therapy, including radical surgery.—*Z. Petrany, M.D.*

HAM, HAROLD J. Radon seed implantation in carcinoma of the bladder. *Proc. Coll. Radiologists, Australasia*, June, 1957, *1*, 21–24. (From: Department of Radiotherapy, Royal Prince Alfred and Royal North Shore Hospitals, Sydney, Australia.)

The author reviewed 86 cases of carcinoma of the bladder treated in Sydney between the years 1937–1952 by surgery and radon seed implantation. A total of 322 cases of bladder carcinoma was seen in

this same period, most receiving other forms of therapy.

The implantation was performed through a cystostomy after the protuberant portions of the tumor were taken down to the level of the adjacent mucosa with the diathermy loop. Radon seeds were placed in a circle or oval, 1 cm. outside the tumor and into the base of the tumor so that a dose of 6,500 r was delivered at 0.5 cm.

The seeds were of 0.5 mm. gold, 2 to 3 mm. in length and contained, for the most part, 0.8 or 0.85 mc of radon, an amount which usually results in placement of seeds in the outer ring in multiples of 4.

Three and five year survivals without recurrence were almost exactly the same, being 30 per cent. Those tumors with diameters of less than 4 cm. and exhibiting little invasion, as evidenced by a lack of induration, showed the best survivals. These 2 criteria establish radon implantation as the method of choice.—*Henry J. Klos, M.D.*

RADIOISOTOPES

Shoemaker, William C., and Wase, Arthur W. Absorption patterns of isotope labelled dietary constituents in postgastrectomy patients. *Surg., Gynec. & Obst.*, August, 1957, *105*, 153–158. (From: The Divisions of Surgery and Biological Chemistry, Hahnemann Medical College and Hospital, Philadelphia, Pa.)

The absorption from the gastrointestinal tract of fat and protein labelled with I^{131} was determined in dogs and humans following Billroth I and Billroth II gastrectomies with normal controls. After ingestion of the I^{131} labelled substances, peripheral blood samples were obtained, and absorption curves were drawn.

These studies indicate that the maximum levels of absorption of fat and protein were reached sooner in the gastrectomized subjects than in the normal controls, but that total absorption was less in the gastrectomized subjects. The absorption of protein was faster following the Billroth II procedure, as compared to the Billroth I, while fat absorption was faster in the Billroth I than in Billroth II.

The radioactive determinations are said to be more accurate than conventional measurements of fat and protein because smaller variations in the blood fat and protein content can be detected by the use of radioisotopes.

The configuration of the postoperative curves is explained on the basis of rapid gastric emptying, due to a smaller gastric reservoir with less complete absorption; thus a peak is reached quickly, but total absorption is less than normal.—*George A. Roberts, M.D.*

Beekman, Z. M. The application of radioactive sodium for the determination of the circulation rate in the lower extremities. *J. belge de radiol.*, 1957, *40*, 313–320. (From: Radiological Department of the Diakonessenhuis, Utrecht, Netherlands.)

A brief résumé of methods of evaluating lower extremity arterial circulation is followed by a description of a technique using Na^{24}. Isotonic $Na^{24}Cl$ is mixed with organic iodine contrast medium (pyelombrine 80 per cent), and injected intravenously, so that a circulation estimate can be made for subsequent arteriography and simultaneously the sensitivity test for the contrast material is performed. Geiger Müller counters are placed between the legs, and are directed at the groin, knee, and ankle of the affected leg.

Apparently satisfactory curves are obtained, but the author does not recommend Na^{24} because: (1) It has a short half life; (2) the short half life, therefore, makes the material expensive to use; and (3) the hard gamma ray emission requires too much lead shielding. I^{131} is suggested by the authors for arterial circulation studies.—*George A. Roberts, M.D.*

Comas, Francisco, and Brucer, Marshall. First impressions of therapy with cesium 137. *Radiology*, August, 1957, *69*, 231–235. (Address: F. Comas, Oak Ridge Institute of Nuclear Studies, Inc., P. O. Box 117, Oak Ridge, Tenn.)

The authors present a preliminary report of 11 patients treated in 1955 with a kilocurie cesium 137 teletherapy machine. The machine is capable of movement in four directions, but clinical use has been made only of arcs of rotation and of conical rotation. The output of the 1,500 curie source is 15 r per minute at 60 cm.

The only criteria for accepting patients for treatment were that the tumor should be radiation-treatable and not too large. No effort was made to select patients on the basis of probable radiocurability. The cesium 137 skin reactions were very similar to those observed with cobalt 60 except that they usually occurred somewhat earlier. The erythema was observed when the skin dose was around 2,000 r in about the third or fourth week of treatment. With the rotation technique as employed, a tumor-skin ratio of between 1.5 and 2.0 usually would be obtained. When the dose was sufficient, the patients responded with a normal disappearance of the tumor or improvement of symptoms much as would be expected with cobalt 60.

The early observations concerning the clinical response of tumors irradiated with simple arc and conical rotation indicate that this is a useful tool for clinical radiation therapy. Comparing Co^{60} and Cs^{137} radiation, no appreciable differences in local and systemic reactions were observed.—*Arno W. Sommer, M.D.*

Czerniak, P., and Harell-Steinberg, A. The chronology of events in the development of subacute thyroiditis, studies by radioactive iodine. *J. Clin. Endocrinol. & Metabol.*, Dec., 1957, *17*, 1448–1453. (From: Government Hospital, Tel-Hashomer, Israel.)

The authors studied 10 patients with subacute thyroiditis at intervals with simultaneous observations of I^{131} uptake and excretion, protein bound iodine serum levels and occasional serum cholesterol and basal metabolism rate determinations. The initial studies were performed between the tenth and sixtieth days after onset of illness, were repeated every fifteen to thirty days the first two months, then every two to four months thereafter.

On the basis of their observations, they divided the disease into 4 stages. The first stage (depression) lasted two months and demonstrated decreased I^{131} uptake in the entire gland, high urinary excretion of I^{131}, normal or high protein bound iodine and, apparently, decreased production of thyroid stimulating hormone.

The second stage (transition) occurred during the third month. The I^{131} uptake was low, normal or high and the protein bound iodine level approached normal.

The third stage (compensation) began at the end of the third month and lasted four weeks. I^{131} uptake increased slightly, protein bound iodine levels fell, and thyroid stimulating hormone production first was high, then returned to normal.

The fourth stage (remission) was characterized by gradual return to normal of all values. In the sixth and seventh months the tests were normal in all subjects.

The authors believe that the low initial I^{131} uptake is explained by the presence of normal hormone in the gland which is then liberated into the bloodstream by the inflammatory process, raising the protein bound iodine, which in turn depresses the thyroid stimulating hormone, resulting in decreased I^{131} uptake.—*Henry J. Klos, M.D.*

Fountain, James R. Treatment of polycythaemia vera with radioactive phosphorus. *Brit. M. J.*, Dec. 7, 1957, *2*, 1335–1337. (From: Department of Medicine, General Infirmary, Leeds, England.)

Radioactive phosphorus (P^{32}) has been used since 1940 in the treatment of polycythemia vera. P^{32} enters into all phases of phosphorus metabolism and the majority of it becomes localized in bone and bone marrow.

Forty-seven patients with polycythemia vera have been treated at the Leeds General Infirmary since 1952. Three millicuries of P^{32} were given intravenously to all patients for the first dose. Venesection was done in only 10 of the cases. The patients were seen at monthly intervals. Changes in symptoms and in erythrocyte, leukocyte and platelet counts were noted at each visit and depending on these findings, further doses of 3 mc of P^{32} were given when necessary. P^{32} was given during the second and third months after the initial injection if needed. In general, falling erythrocyte counts associated with clinical improvement or evidence of depression of granulocytopoiesis or platelet production were indications against further treatment at that time with P^{32}.

The total dose of P^{32} required to produce a remission varied, but in over 50 per cent of the cases the blood returned to a normal state after a total dose of 3 to 6 mc had been given. In 90 per cent of the cases a remission was produced by 9 mc or less of P^{32}. There were 2 refractory cases who eventually died. One died with an acute myeloblastic leukemia and the other with a terminal leuko-erythroblastic anemia.

The remissions produced by P^{32} varied. Eighty per cent had a first remission of over one year. Fifty-six per cent had a first remission of one and one half years and 40 per cent had a first remission of over two years. The longest remission was thirty-seven months and the shortest, two months. Remissions followed second and third courses of therapy.

The therapeutic effect cannot be evaluated for at least thirty to sixty days as the erythrocytes have a life cycle of one hundred and twenty days. The time interval between the start of P^{32} therapy and the return of the erythrocyte count to normal varies, but it usually does so within five months. Leukocyte and platelet counts may drop below the normal level. A transient thrombocytopenia may appear before the erythrocyte level falls and in this case treatment is withheld until the level rises.

The incidence of leukemia is not higher using P^{32} than in the other methods of treatment. The incidence of deaths from vascular complications has been reduced 50 per cent since P^{32} has been used.

P^{32} is generally regarded now as the treatment of choice in polycythemia vera due to the ease of administration and the lack of unpleasant side effects. —*Charles W. Cooley, M.D.*

Carlin, M. Richard. Urological complications following use of radioactive gold for carcinoma of uterine cervix. *J. Urol.*, Nov., 1957, *78*, 650–661. (From: The Department of Surgery [Urology], Washington University School of Medicine, St. Louis, Mo.)

The author discusses the controversy over the management of carcinoma of the uterine cervix between the advocates of surgery and those of irradiation. One cause of failure of either method is that tumor cells are already outside of the effective area of irradiation or operation at the time of initial treatment. More effective methods of irradiating the par-

ametria and pelvic lymph nodes should be explored. One of these methods is the parametrial injection of radioactive colloidal gold, which might improve the over-all results of therapy. However, severe genitourinary tract complications may develop from this type of treatment.

Radioactive gold has been used because the half-life is 2.7 days and 90 per cent of the activity is in the form of beta particles, which tends to give excellent localizing radiation. The method of injection of the material is described in detail.

The series consists of 135 patients treated over a four year period. Eighteen of the patients received radioactive gold followed by Wertheim operation and pelvic lymphadenectomy. Seventy patients received radioactive gold and had a Wertheim operation. One patient was treated with radioactive gold only, and one with gold and external irradiation. Three patients received gold followed by pelvic evisceration.

In 126 of the patients, squamous cell carcinoma of the cervix was found, 7 had adenocarcinoma of the cervix, and 2 had adenocarcinoma of the endometrium. The ages ranged from twenty-one to eighty years.

In 113 cases, no significant urologic sequelae were noted. The remaining 22 showed definite disease and a table is presented with the complications which include hydronephrosis, fistulae and cystitis. Four case reports are detailed, 6 illustrations being used to show these complications. One case developed radiation cystitis immediately following gold injection, two cases had periureteritis with hydronephrosis.

The author states that extensive surgery and irradiation have been accomplished in a series of patients with a urologic morbidity of less than 10 per cent and a mortality of less than 1 per cent. All his cases were limited to Stage I and Stage II lesions of the cervix. He believes that the blame for the complications must be placed on either the radioactive gold injections or the radium applications. In several of his cases complications arose immediately following the gold injections. Ureteral injuries were above the level usually found following the conventional radium application. In 3 cases of pelvic cellulitis, radioactive gold was the causative agent. Radiation ulcers of the bladder were located along the lateral wall of the bladder where the author believes it is most unusual to find ulcers from radium therapy. Urologists should participate more actively in the evaluation of patients with carcinoma of the cervix. A complete urologic investigation before and after treatment, including pyelographic study, should be a routine procedure.—*George W. Chamberlin, M.D.*

VanderLaan, W. P. Accumulation of radioactive iodine; observations on its early phase in hyperthyroid, euthyroid and hypothyroid subjects. *New England J. Med.*, Oct., 1957, *257*, 752–756. (From: Ziskind Research Laboratories, New England Center Hospital, the Boston Dispensary, and the Department of Medicine, Tufts University School of Medicine, Boston, Mass.)

The data presented indicate that observation made during the first hour after the administration of I^{131} provides clear separation between hyperactivity, normal activity and hypoactivity, of the thyroid gland. Also, despite a most rapid rate of accumulation of I^{131} in hyperthyroid patients, the iodine cannot be detected in the thyroid gland by the external counting technique unless thyroid hormone synthesis is blocked. Doses of 3–10 mg. of stable iodide block the hormone synthesis, but do not influence the mechanism for concentrating I^{131}.

Under the conditions of this study, nonthyroid tissue of the neck accounted for about 4 per cent of the radioactivity in the first hour, suggesting that this figure may be subtracted from the percentage estimations of uptake in euthyroid and hyperthyroid persons. Between these two states, a clear separation was achieved as early as ten minutes after the initial intravenous dose.—*Lysle M. Bach. M.D.*

Sheline, Glenn E., and Miller, Earl R. Studies with radioiodine; VI. Evaluation of radioiodine treatment of carcinoma of the thyroid based on the experience at the University of California from 1938 to 1954. *Radiology*, Oct., 1957, *69*, 527–545. (Address: G. E. Sheline, Department of Radiology, University of California Medical Center, San Francisco 22, Calif.)

The authors present an evaluation of radioiodine treatment of carcinoma of the thyroid based on the experience at the University of California from 1938 to 1954. The primary aims were: (a) to treat patients suffering from carcinoma of the thyroid; (b) to develop ways and means of influencing thyroid tissue to take up administered I^{131}; and (c) to study the possible adverse effects of the radiation in patients who received relatively large doses of radioiodine.

Between September 1945 and June 30, 1954, 124 patients with histologically proved primary carcinoma of the thyroid were studied. When possible a 1 to 2 millicurie test dose of I^{131} was administered twenty-four to forty-eight hours prior to surgery. This allowed uptake studies to be made of the thyroid gland and the operative specimens. Of the 124 patients with histologically proved carcinoma of thyroid, 101 were studied but were not given I^{131} for tumor treatment. The remaining 23 patients had inoperable carcinomatous thyroid tissue that did concentrate radioiodine. Definitive I^{131} therapy was instituted for each of these; 18 patients completed the projected course of therapy. The general plan of therapy was to administer orally 100 mc of carrier-free I^{131} at monthly intervals until there was no evi-

dence of tumor uptake or until severe injury precluded further treatment. In 11 of the 18 patients completing therapy, there was objective evidence either of tumor regression or of arrest of growth. Seven of these subsequently died of thyroid carcinoma. In 3 patients the tumors disappeared and had not recurred thirty to forty-six months after the last I^{131} therapy. There was no evidence of tumor regression or arrest in seven patients.

Complete thyroidectomy was found to be the most effective means of increasing the uptake of radioiodine in tumors. The administration of TSH, thiouracil or tapazole resulted in increased uptake by tumor tissue in a few instances. It is concluded that, until better results can be obtained with radioiodine therapy, it will be useful in a relatively small percentage of cases. Surgery and external irradiation remain the treatments of choice whenever the disease can be attacked effectively by these means.—*Arno W. Sommer, M.D.*

MISCELLANEOUS

Goldenberg, Raphael R. Osteogenic sarcoma of the tibia with pulmonary metastasis; report of a case with ten-year survival. *J. Bone & Joint Surg.*, Oct., 1957, *39-A*, 1191–1197. (From: The Department of Orthopaedic Surgery, St. Joseph Hospital, Paterson, N. J.)

The author reports a case of a seventeen year old girl who had a highly malignant osteosarcoma of the tibia. She was treated by a mid thigh amputation. Three and one half years later she was found to have a solitary metastasis in the right lung, and lobectomy was performed. Follow up examinations for the next seven years showed her to remain well, with no evidence of tumor recurrence.

The case is considered noteworthy in view of the long survival and apparent cure—*Arthur E. Childe, M.D.*

Kopp, H. Radiation damage caused by shoe-fitting fluoroscope. *Brit. M. J.*, Dec. 7, 1957, *2*, 1344–1345. (From: The Dermatological Department, Finsen Institute, Copenhagen, Denmark.)

A case history is presented of a fifty-five year old woman who had a typical radiation dermatitis over the dorsum of the right foot. The skin showed atrophy, fine scaling, depigmentation and a network of telangiectases. There was an ulcer under the nail of the second toe that would not heal. The nails of the first, second and third toes were thickened and partially detached. There was no history of roentgen-ray treatments, but the patient had worked in a shoe shop for ten years where a shoe-fitting fluoroscope was used. The shoe-fitting fluoroscope was found to be defective and had exposed the clerk while she operated it. The patient was exposed 15 to 20 times daily and if she placed her right foot on the platform in front of the foot opening, it would receive 9 to 13 r per minute. The transillumination time was usually 30 to 40 seconds. Further study of this apparatus showed that the adult customers' abdomens would receive about 1 r per minute due to the defective fluoroscope. A child's abdomen would receive a greater dose.

It is emphasized that the unnecessary risk of gonadal irradiation should be strongly considered in children and adults in the child bearing years.—*Charles W. Cooley, M.D.*

van den Brenk, H. A. S. Observations of the local roentgen reaction *in vivo* in the Sandison Clark ear chamber. *Proc. Coll. Radiologists, Australasia*, June, 1957, *1*, 29–38. (From: Radiobiological Research Unit, Cancer Institute Board, Melbourne, Victoria, Australia.)

Using a technique which permits direct visualization of small blood vessels in thin (50 to 100 μ) sections in rabbit ears, the author studied the reaction of these vessels to roentgen and gamma radiation. This included the taking of photomicrographs.

A few hours after irradiation, there is a marked increase in vasomotor irritability. Spasm of vessels is precipitated particularly by such extraneous influences as cooling and sudden noises. The irritability begins in a few hours and lasts from days to weeks, depending on the dose (400 to 4,000 r).

A primary erythema dose causes no significant change in the observed vessels, over which there is no epithelium. The changes which occur during the secondary erythema reaction five to fourteen days after irradiation are minimal. Dilatation of vessels occurs, expecially in the venules and capillaries, but it is not nearly as marked as that which occurs during local infection. The author suspects that the erythema reaction depends on the presence of epithelium which liberates secondary substances leading to the erythema. Thus the radiation induced erythema is relatively complex and dynamic, rather than a static phenomenon.

Many observations are discussed, including pharmacologic influences on irradiated vessels, and many photomicrographs are appended.—*Henry J. Klos, M.D.*

Calder, E. A study of the variable angle as a measuring device of linear dimension. *Brit. J. Radiol.*, 1956, *29*, 386–394. (From: Radiological Department, Royal Infirmary, Glasgow, Scotland.)

A device consisting of two arms adjustable to form an angle suited to the dimension of the object to be measured is constructed of roentgen-ray trans-

parent material and has an opaque rod which serves as a pivot and to indicate the apex at the angle. Lead pellets are used to mark distances from the pivot. A right-angled triangle is formed by dropping an imaginary perpendicular from any pellet to the short arm. In practice, the plane of the measuring device is generally adjusted to be parallel to one edge of the film.

Construction methods are described for using the device when (1) the plane of the object and the plane of the device are parallel, (2) the plane of the object and the plane of the device are not parallel, and (3) the plane of the object is not parallel to the film.

Results of experimental measurements of a dry pelvis are discussed using the various construction methods. The accuracy of results is determined by the degree of precision of construction of the device and by the degree of precision applied to the various stages of the procedure.—*Waldo DeVore, M.S.*

Schwarz, Gerhart S. Extended range radiography; preliminary report. *Radiology*, Sept., 1957, *69*, 419–423. (Address: 622 W. 168th St., New York 32, N. Y.)

Narrow subject range is the most serious deficiency of present day roentgenography. The density range which the eye can utilize simultaneously without strain when viewing transparencies extends from 0.2 to 2.7 and represents a density scale of 2.5. Conventional double-coated roentgenographic film possesses a maximum density of 3.2. Maximum utilization of the recorded image is thus impossible. One of the solutions to this problem lies in the manufacture of a film with very thin emulsions, so that its maximum density can be limited to 2.5–2.8.

The author has used blue sensitive single-coated Eastman Kodak antihalation-backed roentgenographic film and has found it capable of extending subject range. This film can be placed in a conventional double-screen cassette with its emulsion facing either the front screen or the back screen and will receive light from only that screen which it faces. This reduces the speed of the film so that the milliampere seconds must be increased by about 60 to 100 per cent. An extended roentgenographic range and a high tolerance to overexposure were observed. A moderate loss of speed was encountered, but it was felt that the advantages of extended range outweighed these deficiencies in certain roentgenographic applications. They can be overcome by technologic modifications, which are discussed briefly.—*Arno W. Sommer, M.D.*

Cova, Pier Luigi, and Pompili, Giuseppe. Tomografia a strato spesso. I. Ricerche sperimentali. (Thick layer laminagraphy. I. Experimental investigations.) *Radiol. med.*, Nov., 1957, *43*, 1057–1081. (From: Istituto di Radiologia dell' Università di Milano, Sez. Radiol. dell'Ist. Naz. per lo Studio e la Cura dei Tumori, Milano, Italy.)

This is the first part of a study on the experimental investigations and practical applications of a technique of laminagraphy which makes it possible to roentgenograph thick layers of the structures to be examined.

After a general analysis and discussion of the various factors which may modify the thickness of the section, the authors report on the results and conclusions of their experience.

The factors which control the thickness of the laminagraphic section are the degree of angulation under which the laminagram is taken, the focus-section distance, and the section-film distance. It is the authors' opinion that the most important factor is the first one and in varying the degree of angulation they have obtained sections of different thickness.

In laminagraphy with 50° angulation the corresponding thickness of the section is 1 mm., with 30° angulation it is 3.5 mm. and with 10° angulation it is 5 mm.—*A. F. Govoni, M.D.*

Cova, Pier Luigi, and Pompili, Giuseppe. Tomografia a strato spesso. II. Applicazioni pratiche. (Thick layer laminagraphy. II. Practical applications.) *Radiol. med.*, Dec., 1957, *43*, 1153–1173. (From: Istituto di Radiologia dell'Università di Milano, Sez. Radiol. dell'Ist. Naz. per lo Studio e la Cura dei Tumori, Milano, Italy.)

Laminagraphy based on the principle of Grossmann-Chaoul and done with 10° angulation makes it possible to roentgenograph layers about 5 mm. thick. In comparison with laminagraphy with angulations of 20°, 30°, and 50°, this method has the advantage of a greater detail of the structures visualized in the section, and the disadvantage of less blurring of the elements surrounding the section.

The best application for laminagraphy with 10° angulation has been found in the examination of the skeletal system and especially of the spine.

Angulations of 30° and 50° have been found useful in laminagraphy of the larynx, mediastinum, and petrous pyramids.

The article has many illustrations demonstrating laminagrams of the skeletal system, mediastinum and larynx, made with various degrees of angulation. —*A. F. Govoni, M.D.*

Sparks, Ollie J., and Shepard, Robert D. Practical application of the 0.3-mm. focal spot; a special cassette holder. *Radiology*, Oct., 1957, *69*, 578–580. (Address: O. J. Sparks, Good Samaritan Hospital, Lexington, Ky.)

This paper describes a "macro" view technique used by the authors to study the progression in healing of femoral neck fractures. A roentgen-ray tube with a 0.3 mm. focal spot is used. The cassette, situated at some distance below the patient who is on a table, was at first held in the correct position by sandbags. The authors found however, that they could not always place the film accurately at right angles to the central ray. The results were roentgenograms of poor quality and detail. With the use of drawings, they describe a special cassette holder constructed of aluminum. One end of the frame is fixed to the housing around the roentgen-ray tube; the other holds the cassette, regardless of angulation, at a fixed distance and at a constant perpendicular to the central ray of the tube. An adjusting device is provided by which the target-film distance may be altered.

One of the more practical applications of this cassette holder was found in the examination of patients with serious spine injuries. The vertebral column may be examined in all planes while the patient remains in either prone or spine position.—*Z. Petrany, M.D.*

Baily, Norman A., and Beyer, Norman S. Surface and entrance dose for a 2-MVP x-ray beam. *Radiology*, Oct., 1957, *69*, 553–557. (Address: N. A. Baily, Roswell Park Memorial Institute, Buffalo 3, N. Y.)

The rapid build-up of ionization with the introduction of absorbing layers into the 2 mv. peak beam, precludes the use of thimble-type ionization chambers for surface dose measurements associated with this beam. Both the magnitude of the surface dose and the nature of the build-up curve can be accurately determined through the use of the Failla extrapolation chamber.

The data reported by the authors were obtained with a 2 mv. peak General Electric roentgen-ray generator. The beam was filtered with 1.0 mm. of lead, giving a half-value layer of 7.6 mm. of lead. The focal chamber distance used was 100 cm. The extrapolation chamber designed for this experiment is described and illustrated. The quantities which were determined are: (a) Surface dose rates as a function of field size; (b) the depth at which the peak dosage rate occurs, 4.0 ± 0.25 mm.; and (c) the magnitude of the peak dosage rate as a function of field size. These are expressed in terms of the air dose rate measured with a thimble chamber whose walls are sufficiently thick to provide electronic equilibrium.—*Arno W. Sommer, M.D.*

Ellinger, F. Protection of guinea pigs against radiation death by cell-free mouse spleen extract. *Science*, Dec. 6, 1957, *126*, 1179–1180. (From: Pharmacology Division, Naval Medical Research Institute, Bethesda, Md.)

Data are presented concerning observations of protection against radiation induced mortality with a cell-free total spleen extract obtained from heterologous material. The extract amounting to 5 mouse spleens per ml. was injected in amounts of 0.2 and 0.4 ml. each day following exposure of both mice and guinea pigs to 550 and 600 r in air of Co^{60} gamma radiation. Data showing the higher dosage of extract to be protective against radiation mortality were statistically significant.

These observations lend support to the theory that a humoral factor of spleen is essential in protection against radiation induced mortality. They indicate that this substance is not a species-specific factor. They offer a justified hope for the eventual identification and isolation of this protective factor.—*Arch H. Hall, M.D.*

Ellinger, F. Pharmacological studies on irradiated animals. I. Scope and methodology exemplified by effect of nucleic acids on radiation induced mortality in mice (preliminary results). *Arch. int. pharmacodyn.*, Feb., 1957, *109*, 377–385. (From: The Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland.)

It is generally recognized that radiation death is a phenomenon to which a great number of factors contribute, such as: (a) Toxic substances originating from primary radiochemical reactions or released from radiation damaged cells; (b) direct effect on vital organs, especially bone marrow; and (c) bacteremia due to lowered body resistance. At various dose levels and in different species, the relative importance of these factors for radiation death varies.

Two main lines of approach in pharmacologic studies of irradiated animals are suggested: (a) The use of various drug concentrations on animals irradiated with one radiation dose; and (b) the use of one drug concentration in combination with 2 or 3 radiation doses. Both of these procedures are exemplified by presentation of preliminary data concerning effects of desoxy- and ribonucleic acid as well as those of a spleen extract on radiation induced mortality in mice. It is pointed out that ribonucleic acid does more to enhance the lethal effect of irradiation than does desoxyribonucleic acid. The spleen extract also increases the lethal effect of radiation.

The author emphasizes the necessity of utilizing the entire lethal dose curve for evaluation of drug effects.—*Arch H. Hall, M.D.*